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A STUDY OF THE TEACHING OF SCIENCE IN THE ELEMENTARY SCHOOLS OF ALBERTA

BY

WARWICK ADAMS BLENCH

A THESIS

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The undersigned certify that they have read, and recommend to the Faculty of Graduate Studies for acceptance, a thesis entitled "A Study of the Teaching of Science in the Elementary Schools of Alberta" submitted by Warwick Adams Blench in partial fulfilment of the requirements for the degree of Master of Education.

ABSTRACT

This study attempted to identify existing organizational and operating plans and practices for teaching science in the elementary schools of the province of Alberta, to determine the type of organizational plans and practices preferred by teachers and administrators, to determine the extent to which teachers feel competent in teaching elementary science, to determine what courses of study were being followed in science education, to determine an indication of respondents' estimates as to the contribution science can make to the objectives of the total elementary school program, to determine the degree of integration of science with other subject areas in the elementary curriculum, and to determine to what extent the elementary classrooms of Alberta have the equipment and facilities to accommodate the science program. In addition, the study investigated the relationship between the above factors and the variables of size of school, type of school, and the teacher characteristics of sex and amount of professional preparation in science education.

To secure the desired information, questionnaires were sent to teachers and principals in a randomly selected sample of thirty urban and thirty rural elementary schools in the province of Alberta. Following the survey, the information received from 48 principals and 466 teachers was tabulated and the findings calculated in per cent. Comparisons between subgroups of the sample were made using the chi-square test of independence.

The results of the study indicated that although the majority of elementary classrooms are being taught science by the classroom teacher, some departmentalization and semi-departmentalization is being used for instruction in science in many schools. This departmentalization or semi-departmentalization is used to a greater extent in the upper elementary grades and is more common in larger schools and in urban schools.

It was found that approximately one-fifth of the teachers have had no professional preparation for teaching elementary science and that slightly more than one-fourth have taken only one course in science in their professional preparation. Approximately ten per cent of the teachers feel incompetent in teaching most or all of the science program. Where departmentalization or semi-departmentalization is being used, the teachers who are teaching science tend to have better than average qualifications for teaching science and to feel competent in teaching most or all of the science program.

The study revealed that except for grades one to three, both principals and teachers prefer to have science taught using a system of departmentalization or semi-departmentalization or by a teacher in the school who is specially qualified for teaching science. Teachers with little or no qualification for teaching science were the ones most likely to prefer a type of organization in which they could "trade" the responsibility for teaching this subject.

A certain degree of integration of science with other

subject matter, particularly with enterprise activities, existed in the elementary schools surveyed; however, there appeared a positive trend to organize for the teaching of science as a separate subject.

Equipment and facilities for instruction in science seemed to be adequate in approximately half of the schools surveyed. Teachers tend to use only one series of science text books even though other series for instruction and enrichment are available.

It was hoped that this survey would provide some useful information that could serve as a guide to future administrative plans. As a result of the findings it was recommended that in grades one to three science should continue to be taught by the classroom teachers, but that in grades four to six organizational provision should be made so that science could be taught by those teachers most capable of giving instruction in the subject. It was further recommended that school staffs be selected so that on each staff there would be at least one teacher with special qualifications in science. It was recommended that teacher education programs provide opportunity for elementary teachers to specialize in science and for school systems to utilize their preparation in the elementary schools of the province.

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CHAPTER I

THE PROBLEM

I. INTRODUCTION

The development of quality curricula in Alberta's schools and classrooms has depended upon, and will continue to depend upon, the efforts of principals and teachers to assess subject matter and programs of study, and to introduce, when necessary, changes that will improve the learning situation for the children they teach. Elementary school science is a subject that seems to have emerged from a condition of virtual integration with other subjects to a subject that is beginning to be treated with emphasis equal to that of other subjects on the elementary school curriculum.

The prime purpose of this study was to examine the status of science education in the elementary schools of Alberta and, thus, to help educators decide what changes may still be needed.

Organization for the teaching of science and the organization of the present content of the science program are treated in some detail in this study. While it is universally recognized that the quality of instruction given is largely dependent upon the individual teacher,

it is also recognized that an additional factor vital to effective teaching is a carefully organized and stimulating program which satisfies the educational staff and contributes to an effective learning situation of the students they teach.

This study surveys present and preferred practices in the schools of Alberta in regard to the organization of the science program. It is based on information received from school principals and classroom teachers. Equipping for science education in the elementary schools is also reported in considerable detail.

II. STATEMENT OF THE PROBLEM

The purpose of this study was to consider the present organizational program for teaching science education in the elementary classrooms of Alberta and to determine the type of organization preferred by the elementary school teachers and administrators and to discover whether current programs meet with the approval of the administrators and teachers concerned.

Specifically the study endeavored to determine the following about the teaching of science in the elementary schools of Alberta.

1. The extent to which elementary school teachers were teaching science to their own classes and to identify the procedure being followed in cases where teachers were

not teaching their own science.

2. The practice and organizational plans that principals and teachers use.

3. The practice and organizational plans that principals and teachers prefer.

4. An indication of teachers' feelings of competence.

5. What courses of study were being followed.

6. An indication of the contribution science can make to the objectives of the total elementary school program.

7. The degree of integration of science with other subject areas in the elementary curriculum.

8. The extent to which the elementary classrooms of Alberta have the equipment and facilities to accommodate the science program.

9. The professional preparation to teach science, of the elementary teachers of Alberta.

10. Suggestions for improvement of the elementary science program.

III. BACKGROUND OF THE PROBLEM

The elementary schools of the province of Alberta are increasingly being held responsible for a more comprehensive curriculum in science. Content of expanded scope

and difficulty is being suggested as well as being shifted from other levels of the curriculum.

Elementary teachers in Alberta are prepared in one of two ways. First, an elementary teacher may have gone to normal school and then upgraded her qualifications by attendance at summer school in a faculty of education. Second, she may have received her initial training by taking a minimum of two years in a faculty of education.

A one-half year science methods course is presently included in the two-year program at the universities in Alberta, thus giving science an equal treatment in methods to that of all other elementary curriculum subjects. A methods course in science may not have been included in the normal school program. This means that many of the teachers in Alberta schools have had no formal preparation, or little preparation, for teaching science.

IV. NEED FOR THE STUDY

Reasons for Concern About Science

Science is rapidly gaining recognition as an important part of the school curriculum. In addition, it is affecting almost all facets of our life both in work and in leisure.

> In this field, as in mathematics the developments of the past few decades have been spectacular. . . . Courses in mathematics have tended to introduce a few of the newer theories and concepts. Significant changes

> have been to broaden courses and push down subject matter to earlier grades for more descriptive treatment.[1]
>
> Nothing less than national security, not to mention our standard of living depend upon extensive and intensive science education.[2]

The traditional integration of science with other subjects on the elementary curriculum has concerned teachers of the science program.

> It is clear that adequate safeguards were lacking, for in 1949 it was officially noted that science education in the elementary grades was ineffectual, if not entirely lacking, and steps were taken to specify more clearly and emphatically what should be studied.[3]

Increasing Importance and Stress on Science Education

Adequate science experiences are presently considered an important part of the total curriculum for the elementary child.

The total educational system of the province of Alberta continues to expand very rapidly. Two of the primary contributing factors noted in the growth of the school system are the centralization in rural areas and the population expansion in the urban areas. Presently, there seems to be an emphasis on the re-examination of the role and the value of various subject areas in elementary education.

There is an emphasis in society today on science, as evidenced in the vast science experimental program in the United States of America--supported by the large sums

of money available for research and experimentation with programs in school science. The enquiry method in science is beginning to be tried and accepted in other areas of the curriculum throughout Canada and the United States.

In Alberta, French, formerly considered an area reserved for secondary schools, is now being successfully taught in many elementary classrooms.

Early childhood education is increasingly being held responsible for the language and basic concepts of the science program.

It is, therefore, becoming evident that science must find its right place amongst the newly added courses in the curriculum of the elementary schools of the province of Alberta.

Improved Facilities and Instruction for Science

Organization of larger school systems and districts may have brought about improvement in the facilities available for instruction in various areas of the curriculum. If this extends to the field of science then changes are possible in the organization for instruction of the science program.

It is noted in the 1962 Annual Report of the Department of Education, the Province of Alberta.

> The impetus given to improved instruction by the new program of study and text books which have been introduced into some subject fields

> during recent years elicited favorable comment. Their beneficial effect on the quality of instruction and on pupil interest and achievement were frequently mentioned in relation to primary reading, science both elementary and junior high grades, and elementary language. (4)
>
> Other subject areas in which instruction was commended frequently included mathematics, science, social studies, and language.(5)

The Royal Commission on Education was concerned about the textbooks used in the teaching of science. The Commission Report has this to say:

> Any series of texts now authorized would provide suitable basic elementary science texts, and many suitable references are available to supplement them. The Commission believes that the above statement should be changed to read: "Make sure that the student goes beyond a single text," and that a text should be prescribed.(3)

Nearly a decade later the 61st Annual Report of the Department of Education reported,

> While many superintendents reported that science instruction was effective, there was a greater incidence of dissatisfaction than in the case of mathematics. Science instruction was heavily oriented to a single textbook, and many teachers were reluctant to develop the experimental and inquiry approaches. (6)

Regarding science and science storage space, even the new schools throughout the province are experiencing difficulty in establishing adequate or efficient facilities for science instruction.

> Nevertheless much uncertainty continues concerning the desirable type of science room. . . . Persistent weaknesses remain for adequate

> and functional storage of science materials. (6)

A re-examination of the observations may contribute to their expansion.

Organization for Instruction in Science

In the elementary schools of Alberta an attempt is being made to make provision for a sequential and developmental program in science. Increasingly, teachers are required to possess a degree of skill and knowledge necessary to teach science successfully. At present, there would seem to be some doubt that all teachers have sufficient knowledge of science, therefore, the problem arises as to whether or not science should be taught by the classroom teacher or by a specialist.

Any organizational plan used to teach science should have the approval of those who are going to implement it, for it would be unwise to plan or insist upon a form of organization that did not have the support of the professional staff who are required to work with it.

It would appear mandatory that what is currently being done in Alberta be known, in order that we can determine how better use may be made of facilities, equipment, and personnel. In this study, principals and teachers were asked to respond regarding present practices and organization for instruction in science, and were also given the opportunity

to state their preferences as to what they consider to be the best plan for teaching science education in elementary classrooms. This study should provide some basis for future decisions about organizational provisions for science education.

V. DESCRIPTION OF THE STUDY

This study sought to identify existing organizational provisions for teaching science education in the elementary schools of Alberta, to determine the type of organizational plans preferred by teachers and principals, to determine the extent to which teachers feel competent in teaching science, to assess the facilities for the teaching of science, and to determine the extent of the contribution of science to the objectives of the elementary school curriculum. In addition, the study investigated the relationship between the above factors and the variables of size of school, type of school, and the teacher characteristics of sex, experience, and amount of professional preparation in science.

To secure the desired information, questionnaires were sent to principals and teachers in a randomly selected sample of thirty city and town schools, and thirty district and county schools in the province of Alberta. Following the survey the information received from 48

principals, and 466 teachers was tabulated and the findings calculated in per cent. Comparisons between sub-groups of the selected sample of approximately ten per cent of the schools in Alberta were made using the chi square test for independence.

VI. DEFINITION OF TERMS

The following terms are defined as they are used in this study:

Elementary Schools. Elementary schools refer to schools in which any of the grades from one to six is taught.

Urban Schools. Urban schools refer to schools located in cities or towns and part of a system having locally appointed superintendents.

Rural Schools. Rural schools refer to schools located in rural areas, villages, towns, or cities, and part of a system having superintendents appointed by the Province of Alberta.

Departmentalization. Departmentalization refers to a method of staff organization under which a teacher spends 50 per cent or more of her time instructing in one subject, or in a group of related subjects in which he or she has some specialized interest and/or training.

Semi-Departmentalization. Semi-departmentalization refers to a situation in the school where a teacher spends

less than 50 per cent of her time in teaching but exchanges or "trades" the teaching of science with another member of the staff.

Equipment and Facilities. Equipment and facilities refer only to that which is available for teaching science.

School Program. This term is used to designate the school science program only.

Special Science Instructor. Special science instructor refers to a teacher who has had professional training in science and science education, and who teaches science to more than one class.

Visiting Specialist. Visiting specialist refers to a person who is employed to assist in the organization and implementation of the science program, and to arrange demonstrations, workshops, and in-service training.

Organizational Plan. The term "organizational plan" refers to the type of course used for instruction in science at the grade level the teacher is presently teaching.

Completely Integrated. The term "completely integrated" refers to teaching of science only in conjunction with another subject contained in the elementary curriculum.

VI. LIMITATIONS OF THE STUDY

The survey was restricted to elementary schools having five or more rooms in operation. There are two reasons for this. First, the trend towards centralization

and towards larger schools means that, in the future, an increasing percentage of our school population will be attending large elementary schools. Second, it is unlikely that there is much opportunity for departmentalization or semi-departmentalization in schools where there are fewer than one teacher per grade. Therefore, the practices in larger schools may more profitably be studied.

The major limitations of the study depend upon the collection of accurate data and information. The following two assumptions must be made in a study of this nature.

1. It is assumed that the sample from which the information was collected is typical of the population studied.

2. The responses recorded in the questionnaires represent the respondents' best judgment about the matters in question.

VII. OVERVIEW

Chapter II is devoted to a review of significant studies on departmentalization and semi-departmentalization, of a review of literature in the field of science as it pertains to organization for instruction, equipping, preferred methods, integration of science, and the professional preparation of staff.

Chapter III outlines the design of the study. It

gives a description of the survey sample and how it was chosen, the questionnaire used, the method of conducting the survey, and the procedures followed in the collection of the data.

Chapter IV is devoted to an analysis and interpretation of the data, together with the tabulated responses of the principals and teachers.

Chapter V reports the conclusions the study will support. Recommendations based on these conclusions are presented.

CHAPTER II

REVIEW OF RELATED LITERATURE

In this chapter related literature is reviewed under the following headings: (1) departmentalized and semi-departmentalized organizations; (2) elementary science textbooks and elementary science equipment; (3) preferred methods of teaching elementary school science; (4) integration of the elementary science program with the entire school program; (5) preparation of science teachers; and (6) summary.

I. RESEARCH ON DEPARTMENTALIZED AND SEMI-DEPARTMENTALIZED ORGANIZATIONS

Subject area specialists, although extensively used in secondary schools, are yet to be fully accepted in elementary schools. Research has been conducted through the use of surveys of teacher and administrator preference of departmentalization in elementary schools, the effect of departmentalization on the mental and social adjustment of the pupils, and the comparative achievement of pupils within self-contained classrooms, semi- or fully-departmentalized schools and non-graded schools. Although few of these studies deal directly with elementary school

science, they do provide a framework for observation of the total program as it could specifically affect the teaching of elementary school science.

Preference of Teachers and Administrators Regarding Departmentalization

Ackerlund (7), in a study reported in 1959, surveyed elementary school teachers in a large American school system and asked for subjective appraisals of the effectiveness of the self-contained classroom. The teachers generally favored the self-contained classroom at the K-1-2 level, some opposition to it was expressed at 3 level. This opposition increased in grades 4, 5, and 6. Most of the teachers surveyed, did not consider themselves well prepared in all subjects they were required to teach.

A study, centered on organizational plans for teaching elementary school music was reported by Peterson (8) in 1957. The sample comprised ninety-six elementary schools in Arizona and the survey questionnaire outlined four possible organizational plans as follows:

Plan A. All music taught by a music specialist with no responsibility for the classroom teacher.

Plan B. Music taught in part by the classroom teacher and in part by a visiting music specialist.

Plan C. All music taught by the classroom teacher.

Plan D. Music taught by classroom teachers who

"trade" subjects with one or more teachers in the school.

In each case, school principals were asked to indicate both the practice in their school and their own preference from among the four alternatives offered at each of three grade levels. Tabulation of data showed that Plan B was the most frequent practice for grades 4-6 and 7-8. Preference ratings favored Plan B for grades 1-3, and Plan A as most favorable for grades 4-8. A conclusion drawn by Peterson was that principals tend to favor organizational plans which make greater use of music specialists in elementary school music.

A doctoral dissertation on elementary school organization by Hansen (9) dated 1953, questioned both experienced and prospective teachers as to their preference between unit classrooms and a departmentalized organization. Factors affecting responses were academic preparation and teaching experience, but, generally, the reporter felt the trend was toward favoring the unit classroom. This study also disclosed that more than one-half of the sample felt ill-prepared to teach art, music, or physical education.

School superintendents in two hundred American school systems were surveyed during 1942 and 1943 by Prince (10) who reported that self-contained classroom organization for elementary grades was considered

superior to departmentalization. Most, however, also reported the desirability of using specialist teachers for art, music, and some other subjects.

A study published in 1927 by Becker and Gleason (11) surveyed representative school administrators and classroom teachers. Results indicated that 50 per cent of the "educators" and 86 per cent of the classroom teachers favored departmentalization.

Anderson (12) in 1962, based a study on Ackerlund's (1) research findings and specifies what are, in his opinion, benefits of teacher specialization in the elementary school. He states that the specialist teacher with subject mastery has a frame of reference from which to evaluate pupil development. Departmentalized organization introduces the student to a greater variety of teaching techniques. Departmentalization may also attract and retain a greater number of male teachers in elementary schools that utilize this form of organization for science instruction.

Another study, by Anderson and Goodlad (13), used as a basis the results of Carbone's (14) research on graded and non-graded elementary schools. Two of their conclusions were, first, that many teachers in designated "non-graded" schools were in fact continuing to use "graded" practices leading toward "graded" goals. They

presumed the reverse would be entirely likely in designated "graded" schools. Second, it is suggested by these authors, that the survey results may tend to be biased because of the limitation placed by traditional achievement tests which are in fact, geared to the curriculum and instruction practices of graded schools.

Munson, (15)in a 1961 article states that there are many school systems so small they cannot economically support specialist supervisors to assist elementary grade generalists in the teaching of science. He presents the interesting idea that the secondary school science teacher, usually a specialist, be relieved of certain extra-curricular assignments and profitably spend his time acting as consultant in science for elementary teachers.

A standard argument used against departmentalization of instruction in elementary schools has been that such organization may create guidance problems by adversely affecting the pupils' social adjustment. Broadhead (16), however, upon examining the Education Index and Dissertation Abstracts for the 1950 and 1960 period, states that there is no research indicating whether semi-departmentalized types of elementary organization promotes good or poor social adjustment among pupils. Livingstone (17) reported in 1961 that semi-departmentalized organization had been in effect in the fifth grade in Tulsa since 1928. The fifth grade

children showed better than average emotional adjustment. Anderson (17), then, on the basis of these two previously cited studies, suggests that with the data now available it must be assumed that the adjustment of children in departmentalized schools is at least not inferior to that of children in self-contained classrooms.

Gibb and Matala (18) conducted a comparison study of fifth and sixth grade students in two groups, those taught by specialist teachers in mathematics and science and those taught these subjects in a self-contained classroom. Some of the evidence indicated more effective learning by pupils with specialist teachers in science, but no significant difference appeared between the two groups in mathematics. Additionally, it was learned that both fifth and sixth grade pupils preferred having several different teachers.

Cole (19) in 1949, has reported on a thorough comparison study of self-contained and departmentalized school organizations conducted by Fred C. Ayer in Seattle elementary schools. Ayer found achievement to be at a higher level in the semi-departmentalized schools.

Anderson (12) writing on the subject of pupil adjustment, suggests that the departmentalized organization offers the pupils a greater number of models for role identification and thereby affects them socially in a more

positive manner.

II. RESEARCH ON ELEMENTARY SCIENCE TEXT BOOKS AND ELEMENTARY SCIENCE EQUIPMENT

Following research by Piltz in elementary schools in Florida in which he found the majority of elementary science programs were based on science text books, Mallison (20) attempted to determine the reading difficulty of science text books for grades 4, 5, and 6. He applied the Flesch formula to a sample of seventy-five texts from within five elementary science series. He found grade 4 texts were too difficult, grade 5 texts were rather difficult, and grade 6 texts were slightly difficult.

A second study by Mallison and Sturm (21) applied the Flesch formula to 191 samples from thirty-four unit-type elementary science text books. They found little encouragement was offered teachers to use unit-type texts because they were above the grade level indicated by the publisher. Such texts might be used at higher grade levels.

Newport (22), in 1965, questioned the advisability of the practice of committee selection of elementary science text books. Rather, he undertook to determine readability level through application of readability formulae. His analysis of nine continuous series of elementary science texts--grades 4, 5, and 6--indicated that they were near

the desired levels for which they were intended.

A study reported in 1958 by Mallison and Holmes, (23) compared the reliability of measurements obtained through the application of readability formulae to elementary science text books and the estimates of difficulty on selected passages made by reading experts and/or elementary teachers. Findings indicated a median difference for measurements using readability formulae of 1.0 years, of 3.0 years in estimates of difficulty by reading experts, and of 4.0 years in estimates by elementary teachers. The researchers concluded that use of reading formulae is justified for elementary science text books.

Burky (24) applied the Yoakam readability formula--based entirely on vocabulary--to recently written elementary science text books. He concluded that, although elementary science texts are generally well written suggested grade placement must be examined carefully before texts are used by elementary grade pupils. He further suggests that continued research and improved vocabulary control would likely result in texts more closely fitting the abilities of intended readers.

In 1924, Pressey (25) analyzed school text books to determine the number of technical words that appeared along with their comparative importance. A number of lists were compiled including a list of the most commonly used science

words. Two conclusions of this study relative to science texts are that the lists should be valuable in determining the vocabulary burden in texts, and that the lists could serve in writing a general science text book organized around common terms in the science vocabulary.

Bradley and Earp (26) write of a program undertaken to provide elementary school pupils with information on the latest developments in science. The procedure followed in this program was to divide two sixth grade classes into two groups each. A highly technical article from a reputable scientific journal was given the control group for study; this same article, re-written at a reading level suitable for the grade level of the students, was given to the experimental group. Conclusions reached were that, although the study sample was limited as to size, an objective test administered to both groups gave significantly higher scores to the experimental group. A second conclusion, was that the articles must be carefully selected and that the scientific concepts should not be too complex. It was further noted that outstanding students in each type of group scored equally well, and that poorer readers tended to score higher within the experimental group.

An interesting study on the use of programmed science materials was reported by Taylor (27). An implication of the study was that teacher attitudes toward the

programmed material did influence pupil achievement and that to gain most efficient use of such material, great care must be exercised in minimizing the apprehensions of teachers in using them. Suggested emphasis would be on assuring teachers that programmed instruction is not a threat to their position, and that successful outcomes are enhanced by their favorable attitude. A major conclusion of the study was that only a selected group of fourth grade students of above average intelligence were able to use the programmed materials successfully, and therefore, the materials should be revised to meet a greater proportion of pupils of varying capabilities in an individualized manner.

Adding impact to the possible need for revision, the study also concluded that individual differences account for twice the variance in final achievement by pupils than did teacher attitudes toward using programmed science materials at the fourth grade level.

Respecting elementary science equipment, an article by Munson (28) takes issue with the common practice of equipping science laboratories and classrooms on the basis of materials allowed under government financial aid programs. Suggesting that a more important criteria are uses that the teacher makes of any equipment, he proposes the following three questions which the teacher must ask himself.

Do I understand the general content of science well enough to use demonstration materials to illustrate concepts and principles with clarity? Will these materials kindle an interest in the children in science? Do I have the competence to use these materials in a way that the children will grow in ability to use the scientific method? Munson then offers a suggested equipment list suitable for an effective elementary science program at a maximum cost of fifteen dollars.

III. RESEARCH ON PREFERRED METHODS OF TEACHING ELEMENTARY SCHOOL SCIENCE

A report on a summer conference in elementary science held in 1962, is given by Morrison and Walcott (29). They suggest that to consider science as a discrete "package" is insufficient and that the view of science as a living complexity makes for more interesting and attractive learning. Science curricula should, in their opinion, be based on themes that organize and integrate and thereby enlighten. They further suggest that stress be placed on the intuitive, hypothetical, and playful, especially in elementary school. These elements are constantly available in the physical situation which introduces a range, over which the teacher and the text book are not entirely in control.

Smith (30) writes of a study comparing five text books on methodology in teaching science. Each author

reviewed worked from the premise that elementary science teachers are expected to teach general science in the broadest sense of the term. If the rationale for including science in the elementary school program relates to certain characteristics and needs of children, the inherent qualities of science, and later educational and social needs, then it is felt that one of two methods of presentation may be adopted. Either the miscellaneous approach may be used, so long as selection is based on inherent value and appropriateness, or the subject matter may be developed through selected basic concepts logically combined to provide an integration of ideas. It was either stated or implied that the elementary science program bore a close relationship in content to other parts of the instruction program, and that it was taught in separate time periods designated "Science," although it impinged frequently on other parts of the curriculum. Ideally, it was felt that the science program be based on active investigation with the reminder that the empirical method be used as a last resort because it is so slow.

An article by Eccles (31) calls for more guidance for elementary teachers of science in planning good programs. If a functional distinction were to be made among the various types of first-hand experiences--experiment and demonstration--then elementary teachers could clearly

choose a work activity for the students to serve the appropriate purpose.

Teaching experiences gained in the use of a revamped science curriculum are reported by Karplus (32) in a 1962 article. The science program studied was developed by research scientists who continued through the two year period to act as resource consultants to the teachers involved. Sufficient equipment was provided for both group experiments and individual pupil experiments. Teachers reported that the children at all grade levels responded with alertness and interest to much of the experimental material, and that the combination of experiment and discovery was stimulating. An interesting finding, deduced under controlled conditions, was that pupils tended to consider the information obtained empirically as less sound information than that given by the teacher or taken from a text book.

Karplus lists some of the problems encountered in the use of this revamped science curriculum. Teachers reported it was most difficult to determine what the children were learning. Classroom observation was incomplete and subjective. Although the laboratory teachers were sensitive to both satisfaction and frustration of pupils, they themselves were not sufficiently experienced with the equipment to judge pupil progress effectively.

A basic difficulty which was encountered was that of communication, since words or phrases tended to differ in significance when used by (1) the scientists, (2) the teachers, and (3) the pupils.

Useful implications of this study are that experimental programs in science must be communicated to teachers in a usable form, and that information provided must go well beyond the minimum required for classroom presentation. Teachers must have a reserve upon which to draw for class discussions and to use as a basis for the required self-confidence needed for before-the-class performance.

The team teaching method is discussed in the report of a study by Lambert, Goodwin, and Wiersma (33). The study used as a control group within the traditional self-contained classroom taught by specialist assistance and an experimental group taught by two multigrade teaching teams, one at the grade 1-5 level and the other at grades 4-6. Teams were composed of two experienced teachers and two teacher interns, each of whom held a degree in a specialized area and was in process of completing requirements for a Master's degree in Education. The authors point up the necessity for flexible scheduling in a team teaching approach. In social studies and science there was much large group instruction with panels, debates, movies, and resource speakers. These were followed by smaller work

groups. An implication of this experiment is that schools introducing team teaching, non-grading, or any other innovation, have an obligation to use controlled techniques to assess the value of the innovation to the pupils.

IV. RESEARCH ON INTEGRATION OF THE ELEMENTARY SCIENCE PROGRAM WITH THE ENTIRE SCHOOL PROGRAM

Anderson (12), in his discussion of teacher specialization at the elementary school level, suggests that integration within the elementary school program is easier with specialist-trained teachers. The real problem, he asserts, is to select appropriate occasions for integration--not juxtaposition--and that generalist teachers are really less well equipped to make decisions of this kind.

West (34) wrote in 1961 of the need to integrate science with social studies and the language arts in order to both expand and enrich the science program, and to accomplish this not at the expense of reading, language, arithmetic, or social studies in terms of instructional time.

Shores (35) surveyed students, parents, teachers, and librarians to determine reading interests and informational needs of children in grades four to eight. He concluded that in all areas examined, science is the most persistent topic of interest.

V. RESEARCH ON PREPARATION OF SCIENCE TEACHERS

Much has been written on the subject of teacher preparation and the literature reviewed here will pertain to teachers generally, and then focus on elementary teacher preparation and science teacher preparation, since none is mutually exclusive of the others.

The adequate academic preparation of prospective teachers was the subject of a book by Conant (36) which was a constituent of the major study he initiated on all facets of the American educational system. The author makes specific suggestions regarding the improvement of existing teacher education programs. Among them are, that all faculties playing a part in educating teachers share the responsibility; that education courses be kept to a minimum of 10 to 20 per cent of the total program; that the hodge-podge of free electives be eliminated; that practice teaching become the focal point in teacher education; and that efforts to train teachers to teach in more than one specialty be abandoned. He also makes suggestions regarding the personnel involved in teacher training programs and states that professors of history, philosophy, psychology, or sociology of education first be competent as historians, philosophers, psychologists, or sociologists; that college programs in elementary education be staffed by many persons who together are truly knowledgeable about

elementary school art, mathematics, science, and so on; and that instructors in methods and supervisors of practice teaching have an intimate acquaintance with the classroom.

Joyce and Hodges (37), in a 1966 article, describe the goals of the teacher education program for elementary teachers at the University of Chicago. Teaching here is seen as a blend of educational decision making, by a person capable of implementing educational decisions because he possesses a wide range of teaching behaviors that he controls rationally. This view sees the professional teacher coping with a variety of classroom settings while simultaneously coping with his own needs as they affect his teaching. The professional teacher possesses the ability to analyze his teaching and, through analysis, to set realistic goals for improving his performance.

Burnett (38) suggests that college level students in education faculties enrolling in science courses designed for research science, applied science, and so on, are not being efficiently trained in science to meet the needs of science teachers. Present science courses, he asserts, are not developed to prepare prospective teachers for the teaching of science, and courses arbitrarily selected from standard offerings fall short of required teaching proficiency. Too often courses are discrete with insufficient relation to each other, or development, one

from another.

Burnett proposes six concepts for educating science teachers:

1. That the professional education of the science teacher should constitute a cohesive, integral, and developmental program that results in the knowledge, insights, and skills that the teacher needs for his job.

2. A professional program that integrates science courses with education courses, must be developed.

3. Sustained attention be given to the process of teaching and learning to the sciences as inquiry.

4. The view of science must be conveyed as tentative and a way of thought.

5. Effective teaching in science through genuinely reflective thought promotes conceptualization.

6. Piece-meal attempts at curriculum reform results in piece-meal and inadequate programs.

Yager (39) reports a study conducted with eight similarly academically prepared teachers, each assigned equal teaching loads. In looking for teacher effects on the outcomes of instruction he learned that an individual teacher affects the degree of content achievement by students, that some teachers can cause the development of greater skill in such areas as critical thinking than others; that a teacher affects student attitude in a given course, and that a teacher's performance need not be

uniformly strong in all aspects of teaching.

Kleinman (40) tells of the shift that has come about in research emphasis, in attempting to identify effective teaching. Rather than using supervisor and student ratings as the basis for assessment, for these are often abstract and molar aspects of teaching behavior, there is now a tendency to attempt to gain objective evaluation of specific behaviors, such as communication patterns recorded by trained observers with abilities to grant meaningful ratings.

VI. SUMMARY

Investigative studies of preferred organizational structure for elementary schools show differing results although it would appear that a greater proportion of teachers and administrators favor the self-contained classroom organization. Preference has been indicated for the use of specialist teachers in such subjects as art, music, and physical education. The majority of generalist elementary school teachers surveyed, did not feel either adequately trained or competent to teach all subjects in the elementary school program. Research also assumes that the adjustment of pupils within semi-departmentalized organizations is not, at least, inferior to that of children in self-contained classrooms.

Study conclusions show the justification for even greater care in the selection of elementary school science text books, since they continue to form the basis for elementary science programs. Research suggests that valuable criteria for the selection of science equipment are the uses to which teachers will put such equipment. Programmed learning for elementary school science is considered valuable, but a note of caution is sounded by stressing that it is essential to pre-condition teachers regarding their role in such programs.

The observation-experiment method of presenting elementary school science is presently considered as more stimulating and satisfying for pupils and is compatible with the developmental approach to learning.

Research suggests specific areas for integration and enrichment of the elementary science program, within the entire school program.

There is general agreement among researchers regarding adequate academic preparation for elementary teachers. Present training is seen as inadequate and specialization at the college level in science does not necessarily lead to proficiency in science teaching.

Bloom's (41) 1959 article states the case--a creative teacher supported by an alert administrative staff, strengthened by ample instructional materials and guided by a flexible curriculum leads to an effective science program for elementary schools.

CHAPTER III

I. SOURCE OF DATA AND PROCEDURES

In order to complete this study, information was obtained from principals and teachers in the elementary schools of Alberta. This chapter outlines the organization of schools in Alberta and gives a brief description of the survey sample and of how it was chosen. The questionnaires used and the procedures followed in the collection of data are described. The chapter concludes with a brief description of the method of analysis of data.

Permission to conduct the survey was obtained from the Chief Superintendent of Schools for the Province of Alberta, and from the superintendents of the schools included in the sample.

The Population Studied

In the province of Alberta at the time of this survey, there were 697 elementary schools having six or more classrooms in operation. Of this total, 342 schools were in cities and towns and were a part of twenty school systems employing their own superintendents. The remaining 355 schools were part of sixty-two divisions or county

systems served by a superintendent appointed by the province(42). This study sampled approximately one-tenth of the elementary schools from the two types of administrative systems. The instrument used was a questionnaire survey.

Private schools in Alberta, and Alberta Indian schools were not included in the sample.

Selection of the Sample

Sixty schools were included in this study. Using the procedure and the Table of Random Numbers, published in the text by Dixon and Massey (43) thirty schools from each of the two types of administrative systems of the province of Alberta were selected randomly.

Information was to be requested from the school principal and all classroom teachers of each school selected.

The Survey Instrument

It was felt that the evolution of a survey instrument that would accurately measure items of data essential to the study was important. A brief description of its evolution and refinement follows.

The initial preparation and form of the survey instrument took place on April 4, 1967. Subsequent refinements were applied on April 20, 25, 27, 28,

utilizing the constructive professional opinions of my supervising university professors. A first printing took place on April 28th. Copies of this first printing were distributed to principals and science teachers of nine City of Edmonton elementary and elementary junior high schools. Included in the nine schools were schools used by the Faculty of Education, University of Alberta, as laboratory schools. Further refinements followed the suggestions and criticisms. A second printing took place on May 4. The instrument then went to a large Edmonton elementary school for a trial run for content, clarity, and timing. There followed a third printing on May 9, 1967. The survey instrument was then felt to be ready to be submitted to the principals and teachers included in the survey.

In order to obtain the desired information from the schools being studied, two types of questionnaires, one for principals on buff paper and one for teachers on white paper, were prepared. Modifications were applied as described in the preceding paragraph.

The teacher questionnaire consists of three main sections. The first section asks for personal data about the respondents, such as the grade level they are teaching, sex, the amount of teaching experience in the elementary school, the number of years of education for

salary purposes, the route of their professional education, and their professional preparation for the teaching of science. The second section is designed to determine the type of organizational plan presently being used for instruction in science, teachers are also asked the number of classrooms, including their own, to which they are teaching science. The first part of section three lists four possible organizational plans, and asks teachers to indicate the type of plan they would prefer at the grade level they are presently teaching. The four plans listed cover the alternatives that might possibly be used for teaching elementary science. They are: (1) science taught by the classroom teacher; (2) science taught by a classroom teacher in the school as a part of a system of departmentalization in which teachers "trade" subjects; (3) science is taught by a special science instructor who is a member of the school staff; (4) science is taught by a visiting specialist who is employed by the district or school system. The second part of section three notes ways that the teacher might prefer, to organized science teaching in her classroom: (1) as a separate subject; (2) completely integrated with other subjects; (3) taught primarily as a separate subject, but with appropriate integration and correlation. The third part of section three is designed to determine whether the respondents feel they are adequately prepared

to teach science. The fourth part of section three allows the teacher to select the type of course of study she uses in teaching science to her class. The last part of section three is designed to allow the teacher to rate the contribution science makes to the objectives of the total elementary school program.

The Principals' questionnaire consists of three sections. The first section asks for personal data about the respondent, and for general information about the school. It also asks principals to indicate what fraction of their total time they have free of teaching duties that they may devote to administration and supervision of instruction. The second section asks principals to indicate: (1) practice in regard to teaching science in their school; (2) the organization of science teaching in their school; (3) the integration of science teaching with other subject areas; (4) the assistance given the school by science specialists employed by the school system in which the principal is employed. The third section asks principals to indicate the type of plan they would prefer for instruction in science in their school. The possible plans listed are the same as those listed in the teacher questionnaire. The remaining parts of section three, deal with the facilities and equipment for science instruction in the principal's school; included are physical plant, A/V

equipment, texts, a basic scale of equipment, as well as the method used to obtain science equipment, and the course of study used in teaching science. Finally, the principal is asked to rate the contribution science makes to the objectives of the total elementary school program.

The principal of each school was asked to fill out a principal questionnaire printed on buff colored paper, and each teacher teaching an elementary grade in the schools selected in the sample, was asked to fill out a teacher questionnaire printed on white paper.

The estimated time to fill out either principal or teacher questionnaire was 4.5 minutes. Copies of the questionnaires and the letter of instructions may be found in Appendices A, B, and C.

Collection of Data

On May 23, 25, and 26, 1967, prior to the mailing of the questionnaires to the schools selected as the sample, a telephone call was made to each superintendent, under whose jurisdiction the schools were operated, for the purpose of explaining the entire survey. Permission to operate the survey was given in every case, with the understanding that the final decision would be up to the principals of the operating schools. A great deal of satisfaction and public relations appeared to be effected by this simple administrative practice.

On May 26, 1967, the questionnaires together with a covering letter, were forwarded to the sixty schools selected for the study. On June 12, follow-up letters and letters of thank-you were sent to all participating schools. Return of questionnaires ranged from June first to July fifth. No returns were received after July 5, 1967.

Returns were received from fifty of the sixty schools in the survey sample. Principals of two of the fifty schools were unable to complete the principal questionnaire due to illness. A total of 446 or 84.4 per cent of teachers in the sample schools, satisfactorily completed the questionnaires, and a total of 48 or 80 per cent of the principals returned a completed questionnaire.

The total number of questionnaires distributed and returned in city and towns, and divisions and counties, is shown in Table I, page 41.

Analysis of Data

One of the purposes of this study was to divide the selected sample into sub-groups according to selected characteristics, and then determine whether differences found to exist among the sub-groups in regard to present practice in teaching science, preferred plans and class-room organization, expressed feelings of competence in teaching science, type of course used and rating of science as to the contribution it can make to the objectives of the

TABLE I

DISTRIBUTION OF QUESTIONNAIRES AND NUMBER OF RETURNS

	Cities and Towns	Divisions and Counties	Total	Per Cent Returned
Principals				
Distributed	30	30	60	
Returned	25	23	48	80
Teachers				
Distributed	304	248	552	
Returned	279	187	466	84.4

TABLE II

NUMBER OF RESPONDENTS CLASSIFIED ACCORDING TO SIZE OF SCHOOL, GRADE LEVEL TAUGHT, SEX AND PROFESSIONAL PREPARATION FOR TEACHING SCIENCE

Information		Principals	Teachers
Size of School			
1 - 5		1	4
6 - 11		17	119
12 - 17		17	169
18 or More		13	174
	Totals	48	466
Elementary Classrooms			
1 - 5		3	17
6 - 11		21	166
12 - 17		17	174
18 or More		7	109
	Totals	48	466
Grade Level Taught			
1		1	86
2		0	86
3		0	73
4		0	78
5		47	69
6		0	74
	Totals	48	466
Sex			
Male		42	68
Female		6	398
	Totals	48	466
Professional Preparation in Science			
No Courses		7	84
One Course		5	127
Two Courses		13	74
Three or More Courses		21	77
Not Reported		2	104
	Totals	48	466

TABLE III

NUMBER OF RESPONDENTS CLASSIFIED ACCORDING TO TOTAL YEARS OF TEACHING EXPERIENCE, ELEMENTARY SCHOOL TEACHING EXPERIENCE, YEARS OF EDUCATION FOR SALARY PURPOSES, AND ROUTE OF PROFESSIONAL EDUCATION

Information	Principals (N)	Teachers (N)
Total Years of Teaching Experience		
1 - 3	1	103
4 - 6	2	78
7 - 9	1	54
10 or More	44	229
Not Reported	0	2
Totals	48	466
Total Years of Teaching Experience in Elementary School		
1 - 3	4	113
4 - 6	8	83
7 - 9	8	63
10 or More	26	205
Not Reported	2	2
Totals	48	466
Years of Education for Salary Purposes		
1	1	162
2	5	121
3	1	63
4	14	74
5	8	17
6	10	7
More than 6	9	17
Not Reported	0	5
Totals	48	466
Route of Professional Education		
Elementary	18	391
Secondary	30	75
Totals	48	466

TABLE IV

DATA CONCERNING PRINCIPALS PARTICIPATING IN STUDY

Information		Principals (N)
Total Number of Years as Principal Including Present Year		
1 - 3		12
4 - 6		4
7 - 9		9
10 or More		23
Not Reported		0
	Total	48
Total Number of Years as Principal of Present School		
1		11
2		4
3		4
4		4
5		1
6 or More		24
	Total	48
Fraction of Total Time Free of Teaching Duties to Devote to Administration and Supervision of Instruction		
All		12
9/10		1
8/10		2
7/10		4
6/10		5
5/10		3
4/10		6
3/10		6
2/10		9
1/10		0
None		0
	Total	48



total elementary school program, were significant at an accepted level. The characteristics investigated were; size of school, grade level taught, sex, and professional preparation for teaching science. Table II shows the size of the surveyed groups.

Additional characteristics investigated were; total years of teaching experience, elementary school teaching experience, years of education for salary purposes, and the route of professional education. The results of these characteristics are shown in Table III.

A final table of data concerned itself with principals only. Data surveyed included total number of years as principal including present year, total number of years as principal of present school, and the fraction of total time free of teaching duties to devote to administration and supervision of instruction. Table IV contains the results of these characteristics of the principal group.

The information from the completed principal and teacher questionnaires was key punched on to I.B.M. cards. These cards were then placed with a DATRAN program for CROS - 2, a program that had been revised from CROS - 1 for the I.B.M. 360 by Flathman in March, 1967 (44). This program, the data cards, plus the I.B.M. cards of instruction for the 7Ø4Ø I.B.M. were taken to the University of Alberta computer centre where the data for the characteristics investigated were arranged in contingency tables,

and the significance of differences were calculated by chi square tests of independence (45), using the 7Ø4Ø I.B.M. computer. In each case, the value of the probability p has been reported. (p represents the probability of entirely chance occurrence of the distribution observed.) A value of p greater than .05 ($p < .05$) indicated no significant difference between the groups being compared. When the value of X^2 was found to be large enough to indicate a probability of .05 or lower ($p \leq .05$) the difference was considered significant for the purpose of this study. Differences which were found to be non-significant were not dealt with any further.

The information obtained from the questionnaire is presented and discussed in Chapter IV.

CHAPTER IV

ANALYSIS AND INTERPRETATION OF DATA

This chapter contains an analysis and summary of the information which was received from the fifty schools which responded to the questionnaires sent them. The material is organized into sections relating to the stated sub-problems; one additional section relates to various suggestions for improvement which were made by the 514 principals and teachers surveyed. The material is organized under the following general headings: (1) existing organizational practices and plans for teaching science; (2) preferred practices and plans for teaching science; (3) teachers' feelings of competence in teaching science; (4) courses of study being followed in teaching science; (5) estimates of the contribution science can make to the objectives of the total elementary school program; (6) the integration of science with other subject areas in the elementary curriculum; and (7) the equipment and facilities to accommodate the elementary science program in Alberta. Where feasible urban (city and town) schools and rural (division and county) schools are separated and tables are shown individually for this type of item separation.

I. EXISTING ORGANIZATIONAL PLANS FOR TEACHING SCIENCE

The way in which science is being taught in the surveyed schools will be dealt with in this section by examining the following items: plans used by individual teachers; class organization used by individual teachers; the relationship between the type of plan teachers are using and the teacher variables of sex and professional preparation for teaching science; the use of departmentalized or semi-departmentalized organization for instructing in science at different grade levels in the surveyed schools; the differences between urban and rural schools, and size of schools, in regard to the type of organization being used; and the characteristics of teachers who are teaching more than one class in science.

Type of Plan Being Used by Teachers

In Part II of the teacher questionnaire, teachers were asked to indicate the plan which best describes the manner in which science is being taught to their classroom and/or other classrooms which they teach at indicated grade levels. The alternative plans listed were:

A. Science is taught by the classroom teacher.

B. Science is taught by a classroom teacher in the school as part of a system of departmentalization

or semi-departmentalization in which teachers "trade" subjects.

C. Science is taught by a special science instructor who is a member of the school staff.

D. Science is taught by a visiting specialist employed by the district or school system.

E. Another plan entirely different from those mentioned in (A) to (D) above.

The information from this part of the questionnaire is tabulated and presented in Tables V and VI. In these and some subsequent tables, the schools are divided into urban and rural schools in accordance with the definitions stated in Chapter I.

All tables will show the two variables used and, in addition, will record the numerical separations, the percentage by rows, the percentage by total, the chi-square test of independence, and the value of the probability p. The significant differences between the groups being compared will be reported in the following manner:

* - significant at the .05 level

** - significant at the .01 level

*** - significant at the .001 level

These asterisks will be noted beside the chi-square rating.

It will be noted throughout this chapter on analysis and interpretation of data that if the number of respondents to any plan, category, or grade is recorded as zero, then it is not recorded or shown on the tables. In using the chi-square method of analysis, it is necessary that no more than 20 per cent of the theoretical cell frequencies are less than five and that a minimum cell frequency is one (46). For this reason certain plans, categories, or grades are excluded from the analysis.

Table V shows the type of plans being used, arranged according to the grade level taught in an urban school. The chi-square test of independence shows a very significant relationship between the grade level and the manner in which science is being taught in an urban school. The percentage, 84.9, indicates that the majority of teachers in all grades, one to six inclusive, are teaching science to their own class. Departmentalization or semi-departmentalization accounts for only 13.2 per cent of the various plans used. The remainder 1.3 per cent use some combination of plans A, B, and C. Table V is shown on page 51.

Table VI shows the type of plans being used arranged according to the grade level taught in a rural school. The chi-square test of independence shows no significant difference. This indicates that there is no

TABLE V

PLANS USED FOR INSTRUCTION IN SCIENCE

URBAN

Grade Level Taught

Plan	1	2	3	4	5	6	Total
A	51	52	41	35	27	52	258
B	0	2	1	10	9	8	50
C (D omitted)	0	0	1	1	5	5	12
E	0	0	0	1	1	2	4
Totals:	51	54	43	47	42	67	304
Percentage by Rows							
A	19.8	20.2	15.9	13.6	10.5	20.2	100.0
B	0.0	6.7	3.3	33.3	30.0	26.7	100.0
C (D omitted)	0.0	0.0	8.3	8.3	41.7	41.7	100.0
E	0.0	0.0	0.0	25.0	25.0	50.0	100.0
Totals:	16.8	17.8	14.1	15.5	13.8	22.0	100.0
Percentage by Total							
A	16.8	17.1	13.5	11.5	8.9	17.1	84.9
B	0.0	0.7	0.3	3.3	3.0	2.6	9.9
C (D omitted)	0.0	0.0	0.3	0.3	1.6	1.6	3.9
E	0.0	0.0	0.0	0.3	0.3	0.7	1.3
Totals:	16.8	17.8	14.1	15.5	13.8	22.0	100.0

Chi-square = 45.268** df = 15, $p < .01$. Very significant.

NOTE: Plans used for instruction are;

A. Science is taught by the classroom teacher.

B. Science is taught by a classroom teacher in the school as part of a system of departmentalization or semi-departmentalization in which teachers "trade" subjects.

C. Science is taught by a special science instructor who is a member of the school staff.

D. Science is taught by a visiting specialist who is employed by the district or school system.

E. Another plan entirely different from A to D above.

TABLE VI

PLANS USED FOR INSTRUCTION IN SCIENCE

RURAL

Plan	Grade Level taught 1	2	3	4	5	6	Total
A	34	32	29	26	22	49	192
B	2	0	0	4	5	4	15
C (D omitted)	0	0	0	1	0	1	2
E	0	0	1	0	0	0	1
Totals:	36	32	30	31	27	54	210
Percentage by Rows							
A	17.7	17.7	15.1	13.5	11.5	25.5	100.0
B	13.3	0.0	0.0	26.7	33.3	26.7	100.0
C (D omitted)	0.0	0.0	0.0	50.0	0.0	50.0	100.0
E	0.0	0.0	100.0	0.0	0.0	0.0	100.0
Totals:	17.1	15.2	14.3	14.8	12.9	25.7	100.0
Percentage by Total							
A	16.2	15.2	13.8	12.4	10.5	23.3	91.4
B	1.0	0.0	0.0	1.9	2.4	1.9	7.1
C (D omitted)	0.0	0.0	0.0	0.5	0.0	0.5	1.0
E	0.0	0.0	0.5	0.0	0.0	0.0	0.5
Totals:	17.1	15.2	14.3	14.8	12.9	25.7	100.0

Chi-square = 21.096 df = 15, $p > .10$ or $.10 < p < .20$. Not significant.

NOTE: Plans used for instruction are:

A. Science is taught by the classroom teacher.

B. Science is taught by a classroom teacher in the school as part of a system of departmentalization or semi-departmentalization in which teachers "trade" subjects.

C. Science is taught by a special science instructor who is a member of the school staff.

D. Science is taught by a visiting specialist who is employed by the district or school system.

E. Another plan entirely different from A to D above.

significant relationship between the grade level and the manner in which science is being taught in a rural elementary school. Percentages indicate that almost all rural elementary teachers teach science to their own class.

Type of Class Organization Used by Teachers

In Part II of the teacher questionnaire, teachers were asked to indicate how science teaching is organized in their classrooms and/or other classrooms in which they teach science. The alternatives listed were:

A. As a separate subject.

B. Completely integrated with other subjects.

C. Taught primarily as a separate subject, but with some integration and correlation.

D. Other methods than noted in A to C above.

The information from this part of the questionnaire is tabulated, analyzed, and presented in Table VII Urban, and Table VIII Rural.

Table VII compares the grade level with the type of classroom organization used in the teaching of science in an urban elementary school.

The chi-square test of independence shows a very significant relationship between grade level taught and how the classroom is organized for the teaching of science in an urban classroom. The percentages indicate that in grades one and two, urban teachers usually completely

TABLE VII

CLASSROOM ORGANIZATION FOR THE TEACHING OF SCIENCE
(URBAN)

Grade Level	Separate Subject	Integrated	Separate Subject Plus Integrated	Other	Total
1	4	18	29	0	51
2	7	19	28	0	54
3	8	1	33	1	43
4	22	1	23	1	47
5	18	1	23	0	42
6	24	3	38	2	67
Totals:	83	43	174	4	304
Percentage by Rows					
1	7.8	35.3	56.9	0.0	100.0
2	13.0	35.2	51.9	0.0	100.0
3	18.6	2.3	76.7	2.3	100.0
4	46.8	2.1	48.9	2.1	100.0
5	42.9	2.4	54.8	0.0	100.0
6	35.8	4.5	56.7	3.0	100.0
Totals:	27.3	14.1	57.2	1.3	100.0
Percentage by Total					
1	1.3	5.9	9.5	0.0	16.8
2	2.3	6.3	9.2	0.0	17.8
3	2.6	0.3	10.9	0.3	14.1
4	7.2	0.3	7.6	0.3	15.5
5	5.9	0.3	7.6	0.0	13.8
6	7.9	1.0	12.5	0.7	22.0
Totals:	27.3	14.1	57.2	1.3	100.0

Chi-square = 82.663** df = 15, $p < .01$. Very significant.



TABLE VIII

CLASSROOM ORGANIZATION FOR THE TEACHING OF SCIENCE
(RURAL)

Grade Level	Separate Subject	Integrated	Separate Subject Plus Integrated	Other	Total
1	8	3	25	0	36
2	2	0	30	0	32
3	9	0	21	0	30
4	10	0	20	1	31
5	11	1	15	0	27
6	16	1	36	1	54
Totals:	56	5	147	2	210
Percentage by Rows					
1	22.2	8.3	69.4	0.0	100.0
2	6.3	0.0	93.8	0.0	100.0
3	30.0	0.0	70.0	0.0	100.0
4	32.3	0.0	64.5	3.2	100.0
5	40.7	3.7	55.6	0.0	100.0
6	29.6	1.9	66.7	1.9	100.0
Totals:	26.7	2.4	70.0	1.0	100.0
Percentage by Total					
1	3.8	1.4	11.9	0.0	17.1
2	1.0	0.0	14.3	0.0	15.2
3	4.3	0.0	10.0	0.0	14.3
4	4.8	0.0	9.5	0.5	14.8
5	5.2	0.5	7.1	0.0	12.9
6	7.6	0.5	17.1	0.5	25.7
Totals:	26.7	2.4	70.0	1.0	100.0

Chi-square = 22.709 df = 15, $.05 < p < .10$

integrate science with other subjects, selecting plan B and C more heavily than plan A. However, in grades 4, 5, and 6 teachers appear to strongly favor either Plan A or Plan C, that is, science taught primarily as a separate subject. Integrating science with other subjects is chosen between only 3 per cent and one per cent of the time by urban teachers.

Table VIII compares the grade level with the type of classroom organization used in the teaching of science in a rural elementary school.

In Table VIII, the chi-square test of independence shows no significant difference. This indicates that there is no significant relationship between the grade level taught and the form of classroom organization employed in the teaching of science in a rural elementary school. Percentages indicate, however, that rural elementary science teachers seem to prefer to teach science as a separate subject but with some integration and correlation with other subjects.

The Relation of Types of Plans Being Used to the Sex of the Teachers

Tables IX and X show the types of plans being used arranged according to the sex of the responding teachers.

The chi-square test of independence shows a significant relationship between the type of plan being used, and

TABLE IX

TYPES OF PLANS BEING USED CLASSIFIED BY SEX OF TEACHERS

(MALE)

Plan	Grade Level Taught 1	3	4	5	6	Total
A. Science taught by classroom teacher	2	1	7	10	70	90
B. Science taught by classroom teacher in school as part of a system departmentalization or semi-depart. in which teachers "trade" subjects.	1	0	1	7	6	15
C. Science is taught by special instructor who is a member of the school staff	0	0	0	2	2	4
D. Another plan entirely different from A to C.	0	0	0	0	0	0
Totals:	3	1	8	19	79	110
Percentage by Rows						
A	2.2	1.1	7.8	11.1	77.8	100.0
B	6.7	0.0	6.7	46.7	40.0	100.0
C	0.0	0.0	0.0	50.0	50.0	100.0
D	0.0	0.0	0.0	0.0	100.0	100.0
Totals:	2.7	0.9	7.3	17.3	71.8	100.0
Percentage by Total						
A	1.8	0.9	6.4	9.1	63.6	81.8
B	0.9	0.0	0.9	6.4	5.5	13.6
C	0.0	0.0	0.0	1.8	1.8	3.6
D	0.0	0.0	0.0	0.0	0.9	0.9
Totals:	2.7	0.9	7.3	17.3	71.8	100.0

Chi-square = 16.769 df = 12, $.10 < p < .20$. Not significant.

TABLE X

TYPES OF PLANS BEING USED CLASSIFIED BY SEX OF TEACHERS

(FEMALE)

Plan	Grade Level Taught 1	2	3	4	5	6	Total
A. Science taught by classroom teacher	83	84	69	54	39	31	360
B. Science taught by classroom teacher in school as part of a system of departmentalization or semi-depart. in which teachers "trade" subjects	1	2	1	13	7	6	30
C. Science taught by special instructor who is member of the school staff	0	0	1	2	3	4	10
D. Another plan entirely different from those mentioned A to C	0	0	1	1	1	1	4
Totals:	84	86	72	70	50	42	404
Percentage by Rows							
A	23.1	23.3	19.2	15.0	10.8	8.6	100.0
B	3.3	6.7	3.3	43.3	23.3	20.0	100.0
C	0.0	0.0	10.0	20.0	30.0	40.0	100.0
D	0.0	0.0	25.0	25.0	25.0	25.0	100.0
Totals:	20.8	21.3	17.8	17.3	12.4	10.4	100.0
Percentage by Total							
A	20.5	20.8	17.1	13.4	9.7	7.7	89.1
B	0.2	0.5	0.2	3.2	1.7	1.5	7.4
C	0.0	0.0	0.2	0.5	0.7	1.0	2.5
D	0.0	0.0	0.2	0.2	0.2	0.2	1.0
Totals:	20.8	21.3	17.8	17.3	12.4	10.4	100.0

Chi-square = 51.910** df = 15, $p < .01$. Very significant.

the sex of the teacher if that teacher is a female. The percentages indicate that 73.3 per cent of female teachers are assigned to grades 1, 2, 3, or 4, and that in those grades they are teaching their own science.

As a contrast, in Table IX the chi-square test of independence shows no significant difference between plan used for teaching science, and the sex of the teacher if that teacher is male. Percentages indicate that 96.4 per cent of male teachers are assigned to grades 4, 5, or 6 and are teaching their own science, or are part of a system of departmentalization or semi-departmentalization.

Professional Preparation for Teaching Science and the Relation of this Factor to Types of Plans Being Used

The number of science courses taken by teachers in urban and in rural schools is presented in Table XI. This table reveals that ninety-one or about 17.7 per cent of the teachers surveyed have taken no course in science as part of their professional training; 132 or 25.7 per cent have taken one course; eighty-seven or 16.9 per cent have taken two courses; and ninety-eight or 19.1 per cent have taken three or more courses. One hundred and six or 20.6 per cent of respondents surveyed did not report on this item.

The chi-square test of independence shows a . significant difference. This indicates that there is a

TABLE XI

PROFESSIONAL PREPARATION FOR TEACHING SCIENCE

Number of Professional Courses in Science	Urban Teachers	Rural Teachers	Totals
1. No Course	45	46	91
2. One Course	86	46	132
3. Two Courses	55	32	87
4. Three or More Courses	65	33	98
5. Not Reported	53	53	106
Totals:	304	210	514
Percentage by Rows			
1. No Course	49.5	50.5	100.0
2. One Course	65.2	34.8	100.0
3. Two Courses	63.2	36.8	100.0
4. Three or More Courses	66.3	33.7	100.0
5. Not Reported	50.0	50.0	100.0
Totals:	59.1	40.9	100.0
Percentage by Total			
1. No Course	8.8	8.9	17.7
2. One Course	16.7	8.9	25.7
3. Two Courses	10.7	6.2	16.9
4. Three or More Courses	12.6	6.4	19.1
5. Not Reported	10.3	10.3	20.6
Totals:	59.1	40.9	100.0

Chi-square = 11.868* df = 4, $p < .02$. Significant.

TABLE XII

TYPES OF PLANS BEING USED CLASSIFIED BY SCIENCE COURSES TAKEN BY TEACHER

Type of Plan	Number of Professional Courses in Science: No Courses	One Course	Two Courses	3 or More Courses	Not Reported	Totals
	1	2	3	4	5	
A. Science taught by classroom teacher	80	117	76	80	97	450
B. Science taught by classroom teacher in school as part of system of departmentalization or semi-depart. in which teachers "trade" subjects	8	13	8	10	6	45
C. Science taught by special instructor who is a member of the school staff	2	2	2	6	2	14
D. Another plan entirely different from those mentioned in A to C above	1	0	1	2	1	5
Totals:	91	132	87	98	106	514
Percentage by Rows						
A	17.8	26.0	16.9	17.8	21.6	100.0
B	17.8	28.9	17.8	22.2	13.3	100.0
C	14.3	14.3	14.3	42.9	14.3	100.0
D	20.0	0.0	20.0	40.0	20.0	100.0
Totals:	17.7	25.7	16.9	19.1	20.6	100.0
Percentage by Total						
A	15.6	22.8	14.8	15.6	18.9	87.5
B	1.6	2.5	1.6	1.9	1.2	8.8
C	0.4	0.4	0.4	1.2	0.4	2.7
D	0.2	0.0	0.2	0.4	0.2	1.0
Totals:	17.7	25.7	16.9	19.1	20.6	100.0

Chi-square = 9.959 df = 12, $.50 < p < .70$. Not significant.

significant relationship between teacher preparation for teaching science and location. Teachers located in urban centres have had more professional training to teach science.

Table XII, page 61, shows the types of plans being used arranged according to the number of professional science courses that teachers have taken. The chi-square test of independence shows no significant difference. This indicates that there is no significant relation between the number of science courses the teachers have taken, and the manner in which science is being taught. Percentages indicated that 17.7 per cent of teachers in the sample are teaching science with no professional training in science.

Organizational Plans Used at Different Grade Levels

In Part II of both the principals' questionnaire and teachers' questionnaire under the heading "practice in regard to the teaching of science in your school," item B enquires as to whether science is taught by a classroom teacher in the school as part of a system of departmentalization or semi-departmentalization in which teachers "trade" subjects.

In responding affirmatively to this item principals and teachers were indicating only that some

departmentalization or semi-departmentalization was being used. It did not mean that all classes at any particular grade were using this form of organization.

Table XIII shows the per cent of urban and of rural schools that were using some form of departmentalization at each of the six grade levels. The percentages indicate that there is approximately equal use made of departmentalization throughout the grades with the most use being made at the grade six level (19.7 per cent).

In order to determine whether there is a significant difference between grade levels in the use that is being made of departmentalized or semi-departmentalized instruction in science the chi-square test of independence was applied. Table XIV shows the tabulation and results of this analysis.

The chi-square test of independence shows that there is no significant difference between grade levels and the use of departmentalized or semi-departmentalized forms of organization for the science program.

Organizational Plans Used in Urban and in Rural Schools

In order to determine whether there are significant differences in the types of organization used for instruction in science in urban and in rural schools, responses

TABLE XIII

DEPARTMENTALIZED OR SEMI-DEPARTMENTALIZED ORGANIZATION FOR TEACHING SCIENCE AT DIFFERENT GRADE LEVELS

	Percentage of Schools		
Grade Level	Urban	Rural	Totals
I	15.8	1.0	16.8
II	15.8	2.0	17.8
III	13.2	1.0	14.1
IV	14.1	1.3	15.5
V	12.5	1.3	13.8
VI	19.7	2.3	22.0
Totals:	91.1	8.9	100.0

TABLE XIV

DIFFERENCES BETWEEN GRADE LEVELS IN THE USE OF DEPARTMENTALIZED OR SEMI-DEPARTMENTALIZED ORGANIZATION

Use of Departmentalized or Semi-Departmentalized Organization	Grade Levels 1	2	3	4	5	6	Totals
1. No	84	80	70	73	64	108	479
2. Yes	3	6	3	5	5	13	35
Totals:	87	86	73	78	69	121	514
Percentage by Rows							
1. No	17.5	16.7	14.6	15.2	13.4	22.5	100.0
2. Yes	8.6	17.1	8.6	14.3	14.3	37.1	100.0
Totals:	16.9	16.7	14.2	15.2	13.4	23.5	100.0
Percentage by Total							
1. No	16.3	15.6	13.6	14.2	12.5	21.0	93.2
2. Yes	0.6	1.2	0.6	1.0	1.0	2.5	6.8
Totals:	16.9	16.7	14.2	15.2	13.4	23.5	100.0

Chi-square = 5.383 df = 5, $.30 < p < .50$. Not significant.

both the teachers' and principals' questionnaires are tabulated and analyzed in Table XV for urban respondents and Table XVI for rural respondents.

TABLE XV

DEPARTMENTALIZED OR SEMI-DEPARTMENTALIZED ORGANIZATION IN URBAN SCHOOLS

Grade Level	Schools Using Some Departmentalized or Semi-Departmentalized Organization: Yes	No	Total
I	48	3	51
II	48	6	54
III	40	3	43
IV	43	4	47
V	38	4	42
VI	60	7	67
Totals:	277	27	304
Percentage by Rows			
I	94.1	5.9	100.0
II	88.9	11.1	100.0
III	93.0	7.0	100.0
IV	91.5	8.5	100.0
V	90.5	9.5	100.0
VI	89.6	10.4	100.0
Totals:	91.1	8.9	100.0
Percentage by Total			
I	15.8	1.0	16.8
II	15.8	2.0	17.8
III	13.2	1.0	14.1
IV	14.1	1.3	15.5
V	12.5	1.3	13.8
VI	19.7	2.3	22.0
Totals:	91.1	8.9	100.0

Chi-square = 1.324 df = 5, $.90 < p < .95$. Not significant.

TABLE XVI

DEPARTMENTALIZED OR SEMI-DEPARTMENTALIZED ORGANIZATION IN RURAL SCHOOLS

Grade Level	Schools Using Some Departmentalized or Semi-Departmentalized Organization: Yes	No	Total
I	36	0	36
II	32	0	32
III	30	0	30
IV	30	1	31
V	26	1	27
VI	48	6	54
Totals:	202	8	210
Percentage by Rows			
I	100.0	0.0	100.0
II	100.0	0.0	100.0
III	100.0	0.0	100.0
IV	96.8	3.2	100.0
V	96.3	3.7	100.0
VI	88.9	11.1	100.0
Totals:	96.2	3.8	100.0
Percentage by Total			
I	17.1	0.0	17.1
II	15.2	0.0	15.2
III	14.3	0.0	14.3
IV	14.3	0.5	14.8
V	12.4	0.5	12.9
VI	22.9	2.9	25.7
Totals:	96.2	3.8	100.0

Chi-square = 11.767* df = 5 $< p <$ .05. Significant.



TABLE XVII

TYPES OF PLANS BEING USED IN URBAN AND RURAL SCHOOLS

Type of Plan	Urban	Rural	Totals
A. Science is taught by the classroom teacher	258	192	450
B. Science is taught by classroom teacher in the school as part of a system of departmentalization or semi-departmentalization in which teachers "trade" subjects	30	15	45
C. Science is taught by special science instructor who is a member of the school staff	12	2	14
E. Another plan entirely different from those mentioned in A to C above	4	1	5
Totals:	304	210	514
Percentage by Rows			
A.	57.3	42.7	100.0
B.	66.7	33.3	100.0
C.	85.7	14.3	100.0
E.	80.0	20.0	100.0
Totals:	59.1	40.9	100.0
Percentage by Total			
A.	50.2	37.4	87.5
B.	5.8	2.9	8.8
C.	2.3	0.4	2.7
E.	0.8	0.2	1.0
Totals:	59.1	40.9	100.0

Chi-square = 6.655 df = 3, $.05 < p < .10$. Not significant.

Chi-square (3) $\geq$ 7.815 significant at .05.

The chi-square test of independence as applied in Table XV shows that there is no significant difference between urban schools and the use made of departmentalization or semi-departmentalization for instruction in science.

The chi-square test of independence as applied in Table XVI shows that there is a significant relation between rural schools and the use made of departmentalization or semi-departmentalization for instruction in science.

Table XVII shows the type of plan individual teachers are using arranged according to urban and to rural schools.

The chi-square test of independence shows that there is no significant difference between urban and rural schools in regard to the types of organizational plans that teachers are using for instruction in science.

Organizational Plans Used in Large and Small Schools

In order to determine whether there is any relation between the size of schools and the type of organization being used for instruction in science, schools were classified as large (12 or more rooms) and small (1 to 11 rooms), and data concerning present practice received

TABLE XVIII

DEPARTMENTALIZED OR SEMI-DEPARTMENTALIZED ORGANIZATION IN LARGE SCHOOLS

Grade Level	Schools Using Some Departmentalized or Semi-Departmentalized Organization: Yes	No	Totals
I	59	3	62
II	62	6	68
III	53	3	56
IV	54	4	58
V	47	4	51
VI	70	9	79
Totals:	345	29	374
Percentage by Rows			
I	95.2	4.8	100.0
II	91.2	8.8	100.0
III	94.6	5.4	100.0
IV	93.1	6.9	100.0
V	92.2	7.8	100.0
VI	88.6	11.4	100.0
Totals:	92.2	7.8	100.0
Percentage by Total			
I	15.8	0.8	16.6
II	16.6	1.6	18.2
III	14.2	0.8	15.0
IV	14.4	1.1	15.5
V	12.6	1.1	13.6
VI	18.7	2.4	21.1
Totals:	92.2	7.8	100.0

Chi-square = 2.817 df = 5, $.70 < p < .80$. Not significant.

Chi-square $\underset{(5)}{>}$ - 11.07 significant at the .05 level.



TABLE XIX

DEPARTMENTALIZED OR SEMI-DEPARTMENTALIZED ORGANIZATION IN SMALL SCHOOLS

Grade Level	Schools Using Some Departmentalized or Semi-Departmentalized Organization: Yes	No	Total
I	25	0	25
II	18	0	18
III	17	0	17
IV	19	1	20
V	17	1	18
VI	38	4	42
Totals:	134	6	140
Percentage by Rows			
I	100.0	0.0	100.0
II	100.0	0.0	100.0
III	100.0	0.0	100.0
IV	95.0	5.0	100.0
V	94.4	5.6	100.0
VI	90.5	9.5	100.0
Totals:	95.7	4.3	100.0
Percentage by Totals			
I	17.9	0.0	17.9
II	12.9	0.0	12.9
III	12.1	0.0	12.1
IV	13.6	0.7	14.3
V	12.1	0.7	12.9
VI	27.1	2.9	30.0
Totals:	95.7	4.3	100.0

Chi-square = 5.591 df = 5, $.30 < p < .50$ Not significant.

Chi-square $_{(5)}$ > 11.07 significant at the .05 level.



from all respondents in large and small schools were compared.

Table XVIII shows the number of large schools using some departmentalization or semi-departmentalization at different grade levels.

Table XIX shows the number of small schools using some departmentalization or semi-departmentalization at different grade levels.

The chi-square test of independence for Tables XVIII and XIX shows no significant relation. This indicates that there is no significant relation between size of school and the use that is being made of some departmentalized or semi-departmentalized organization in science in the elementary school.

Table XX shows the type of plan individual teachers are using arranged according to large and small schools. The chi-square test of independence shows no significant difference. This indicates that there is no significant relation between size of school and the type of organizational plan teachers are using.

Characteristics of Teachers Who are Teaching More than One Class in Science

Twenty-six of the 514 teachers in the schools surveyed were teaching science to two or more classes. The number of science classes taught by each teacher

TABLE XX

TYPE OF PLAN BEING USED CLASSIFIED BY SIZE OF SCHOOL

Type of Plan	1 1 to 5 Rooms	2 6-11 Rooms	3 12-17 Rooms	4 18 or more Rooms	Totals
A. Science taught by classroom teacher	5	124	157	164	450
B. Science taught by classroom teacher in the school as part of a system by departmentalization or semi-departmentalization in which teachers "trade" subjects	0	11	21	13	45
C. Science is taught by a special science instructor who is a member of the school staff	0	0	6	8	14
E. Another plan entirely different from those mentioned in A to C above	0	1	2	2	5
Totals:	5	136	186	187	514
Percentage by Rows					
A.	1.1	27.6	34.9	36.4	100.0
B.	0.0	24.4	47.6	28.9	100.0
C.	0.0	0.0	42.9	57.1	100.0
E.	0.0	20.0	40.0	40.0	100.0
Totals:	1.1	26.5	36.2	36.4	100.0
Percentage by Total					
A.	1.0	24.1	30.5	31.9	87.5
B.	0.0	2.1	4.1	2.5	8.8
C.	0.0	0.0	1.2	1.6	2.7
E.	0.0	0.2	0.4	0.4	1.0
Totals:	1.0	26.5	36.2	36.4	100.0

Chi-square = 8.907 df = 9 $.30 < p < .50$

Chi-square$_{(9)} \geq$ 16.92 significant at the .05 level.

was compared to the teacher variables of sex and professional preparation in science, in order to determine the characteristics of those teachers who were teaching science to two or more classes.

Table XXI shows the number of science classes teachers instruct arranged according to the sex of the teachers.

The chi-square test of independence shows a very significant difference. This indicates that there is a very significant relation between the number of science classes teachers are instructing, and the sex of the teachers. The percentages indicate that female teachers are teaching slightly more science classes than are the male teachers. 5.1 per cent of all teachers surveyed, teach two or more science classes.

Table XXII shows the number of science classes teachers instruct arranged according to the number of science courses teachers have taken as a part of their professional preparation.

The chi-square test of independence indicates that there is a very significant relation between teachers' preparation in science, and the number of science classes they are instructing. The percentages indicate that there is a tendency for teachers with more professional preparation in science, to be teaching

TABLE XXI

NUMBER OF SCIENCE CLASSES TAUGHT CLASSIFIED BY SEX OF TEACHERS

Number of Classes Taught	Sex of Teacher: Male	Female	Total
None	5	5	10
One	93	385	478
Two	7	11	18
Three or More	5	3	8
Totals:	110	404	514
Percentage by Rows			
None	50.0	50.0	100.0
One	19.5	80.5	100.0
Two	38.9	61.1	100.0
Three or More	62.5	37.5	100.0
Totals:	21.4	78.6	100.0
Percentage by Total			
None	1.0	1.0	1.9
One	18.1	74.9	93.0
Two	1.4	2.1	3.5
Three or More	1.0	0.6	1.6
Totals:	21.4	78.6	100.0

Chi-square = 17.244 df = 3 $p < .01$ very significant.

$\text{Chi-square}_{(3)} \geq 11.341$ significant at the .01 level.

TABLE XXII

NUMBER OF SCIENCE CLASSES TAUGHT CLASSIFIED BY TEACHERS' PROFESSIONAL PREPARATION IN SCIENCE

Number of Classes Taught	Number of Professional Courses in Science: 1 No Course	2 One Course	3 Two Courses	4 3 or More Courses	5 Not Reported	Totals
None	3	0	2	3	2	10
One	82	124	84	85	103	478
Two	4	8	1	4	1	18
Three or More	2	0	0	6	0	8
Totals:	91	132	87	98	106	514
Percentage by Rows						
None	30.0	0.0	20.0	30.0	20.0	100.0
One	17.2	25.9	17.6	17.8	21.5	100.0
Two	22.2	44.4	5.6	22.2	5.6	100.0
Three or More	25.0	0.0	0.0	75.0	0.0	100.0
Totals:	17.7	25.7	16.9	19.1	20.6	100.0
Percentage by Total						
None	0.6	0.0	0.4	0.6	0.4	1.9
One	16.0	24.1	16.3	16.5	20.0	93.0
Two	0.8	1.6	0.2	0.8	0.2	3.5
Three or More	0.4	0.0	0.0	1.2	0.0	1.6
Totals:	17.7	25.7	16.9	19.1	20.6	100.0

Chi-square = 29.483 df = 12 $p < .01$ very significant.

more science in the schools surveyed. Of concern to the author was the large number of teachers surveyed, who did not respond to this area of research, 106 out of the total 514 respondents, or approximately twenty per cent.

II. PREFERENCE IN REGARD TO ORGANIZATION FOR INSTRUCTION IN SCIENCE

Section two of the analysis and interpretation of data deals with the type of organization that teachers and principals favor for instruction in elementary school science. It includes the organizational plans favored by principals and teachers at different grade levels, and the relationships that exist between the type of plan teachers prefer, and the teacher variables of sex and professional preparation for teaching science. The relationship between the plans preferred by teachers and the plans being used by teachers, is also assessed.

Plans Favored by Principals and Teachers

In Part III of the principals' and teachers' questionnaires, the respondents are asked to indicate which of five plans they would prefer for instruction in science at the grade level at which they teach. The alternative organizational preferred plans listed in both the principal and teacher questionnaires were:

A. Science taught by the classroom teacher.

B. Science taught by a classroom teacher in the school as a part of a system of departmentalization or semi-departmentalization in which teachers "trade" subjects.

C. Science is taught by a special science instructor who is a member of the school staff.

D. Science is taught by a visiting specialist who is employed by the district or school system.

E. Other arrangements.

The type of organizational plan selected by principals at each grade level and the plans selected by teachers, for the grade level at which they teach are summarized in Table XXIII in the form of percentages. It is noted that principals surveyed, taught only at grade one and grade six level. Plan D was not selected by either principals or teachers surveyed, and other arrangements were noted as some combination of plans A, B, or C.

It is apparent from the percentages noted in Table XXIII that the plans favored by teachers and principals vary according to grade level. In order to examine preferred plans at each grade level more closely, and to determine whether there are significant differences between grade levels, the preferred plans of principals

TABLE XXIII

PERCENTAGE OF PRINCIPALS AND TEACHERS FAVORING PARTICULAR ORGANIZATIONAL PLANS

	Principals						Teachers					
	Grades						Grades					
Plan	1	2	3	4	5	6	1	2	3	4	5	6
A	-	-	-	-	-	97.9	18.2	18.0	15.0	13.1	10.5	11.6
B	2.1	-	-	-	-	-	0.2	0.4	0.2	3.0	3.0	2.6
C	-	-	-	-	-	-	0.0	0.0	0.2	0.4	1.1	1.3
D	-	-	-	-	-	-	-	-	-	-	-	-
E	-	-	-	-	-	-	0.0	0.0	0.2	0.2	0.2	0.4

*Note: 48 principals

**Note: 466 teachers

NOTE: Plans preferred for instruction are:

A. Science is taught by the classroom teacher.

B. Science is taught by a classroom teacher in the school as part of a system of departmentalization or semi-departmentalization in which teachers "trade" subjects.

C. Science is taught by a special science instructor who is a member of the school staff.

D. Science is taught by a visiting specialist who is employed by the district or school system.

E. Another plan entirely different from A to D above.

TABLE XXIV

ORGANIZATIONAL PLANS FAVORED BY PRINCIPALS AT DIFFERENT GRADE LEVELS

Plan	Grade Level 1	2	3	4	5	6	Totals
A	0					47	47
B	1					0	1
Totals	1					47	48
Percentage by Rows							
A	0.0					100.0	100.0
B	100.0					0.0	100.0
Totals:	2.1					97.9	100.0
Percentage by Total							
A	0.0					97.9	97.9
B	2.1					0.0	2.1
Totals:	2.1					97.9	100.0

Principals surveyed did not teach in grades 2 to 5 inclusive. Nor did they use Plan C, D, or E in any grade from 1 to 6 inclusive.

Chi-square = 11.495** df = 1 $p < .01$ a significant relationship.

NOTE: Plans preferred for instruction are:

A. Science is taught by the classroom teacher.

B. Science is taught by a classroom teacher in the school as part of a system of departmentalization or semi-departmentalization in which teachers "trade" subjects.

C. Science is taught by a special science instructor who is a member of the school staff.

D. Science is taught by a visiting specialist who is employed by the district or school system.

E. Another plan entirely different from A to D above.

and teachers are presented separately in Tables XXIV and XXV.

Applying the chi-square test of independence to the plans favored by principals and those favored by teachers, it was found that in each case there is a significant difference between grade levels in the choice of plans.

Almost all principals surveyed, taught science in grade six and preferred Plan A. The one principal who differed, taught grade one and preferred Plan B.

Percentages show that teachers of all grades tend to favor Plan A, but that its use gradually diminishes from grades one to six. In grades 4 to 6 teachers seem to prefer to use some form of Plan B and C to augment or replace Plan A. 1.1 per cent of the teachers surveyed had created a plan of their own, but the information received suggested that it was in essence a plan very similar to Plan A.

It may therefore be stated that there is a significant relationship between the grade level taught, and the instructional plans used for teaching elementary school science.

The Relation of Preferred Plan to the Sex of the Teacher

Table XXVI shows the types of plans favored by teachers, arranged according to the sex of the responding teachers.

TABLE XXV

ORGANIZATIONAL PLANS FAVORED BY TEACHERS AT DIFFERENT GRADE LEVELS

Plan	Grade Level 1	2	3	4	5	6	Total
A	85	84	70	61	49	54	403
B	1	2	1	14	14	12	44
C	0	0	1	2	5	6	14
E	0	0	1	1	1	2	5
Totals:	86	86	73	78	69	74	466
Percentage by Rows							
A	21.1	20.8	17.4	15.1	12.2	13.4	100.0
B	2.3	4.5	2.3	31.8	31.8	27.3	100.0
C	0.0	0.0	7.1	14.3	35.7	42.9	100.0
E	0.0	0.0	20.0	20.0	20.0	40.0	100.0
Totals:	18.5	18.5	15.7	16.7	14.8	15.9	100.0
Percentage by Total							
A	18.2	18.0	15.0	13.1	10.5	11.6	86.5
B	0.2	0.4	0.2	3.0	3.0	2.6	9.4
C	0.0	0.0	0.2	0.4	1.1	1.3	3.0
E	0.0	0.0	0.2	0.2	0.2	0.4	1.1
Totals:	18.5	18.5	15.7	16.7	14.8	15.9	100.0

Chi-square = 61.943** df = 15 $p < .01$. Significant relationship

Note: Plan D had no respondents.
Plan E did not vary from some combination of A, B, or C.

NOTE: Organization plans preferred are:

A. Science is taught by the classroom teacher.

B. Science is taught by a classroom teacher in the school as part of a system of departmentalization or semi-departmentalization in which teachers "trade" subjects.

C. Science is taught by a special science instructor who is a member of the school staff.

D. Science is taught by a visiting specialist who is employed by the district or school system.

E. Another plan entirely different from A to D above.

The chi-square test of independence indicates that there is a significant relation between the plans favored by teachers, and the sex of teachers. Percentages indicated that approximately half of all teachers surveyed, male and female, prefer to teach their own science, that approximately one-fifth prefer to have science taught in some form of departmentalization or semi-departmentalization, and that slightly more than one-fifth of the teachers surveyed prefer to have science taught by a special science teacher, who is a member of the school staff, approximately two per cent favor science being taught by a visiting specialist.

Males seem to prefer science taught by a special science instructor, or by some form of departmentalization or semi-departmentalization. This difference noted between male and female teachers in their choice of plans is probably related to the fact that most male teachers are teaching in the upper elementary grades, and it has previously been established in this analysis, that most teachers teaching in the upper elementary grades prefer either Plan B or Plan C.

The Relation of Preferred Plan to the Teacher's Professional Preparation for Teaching Science

Table XXVII shows the types of plans preferred by teachers, arranged according to the number of physical

TABLE XXVI

PREFERRED PLANS CLASSIFIED BY SEX OF TEACHERS

Plan	Male	Female	Totals
A	42	222	264
B	37	79	116
C	28	91	119
D	1	9	10
E	2	3	5
Totals:	110	404	514
Percentage by Rows			
A	15.9	84.1	100.0
B	31.9	68.1	100.0
C	23.5	76.5	100.0
D	10.0	90.0	100.0
E	40.0	60.0	100.0
Totals:	21.4	78.6	100.0
Percentage by Total			
A	8.2	43.2	51.4
B	7.2	15.4	22.6
C	5.4	17.7	23.2
D	0.2	1.8	1.9
E	0.4	0.6	1.0
Totals:	21.4	78.6	100.0

Chi-square = 14.452^{**} df = 4 $p < .01$ A significant relationship.

NOTE: Preferred plans are:

A. Science is taught by the classroom teacher.

B. Science is taught by a classroom teacher in the school as part of a system of departmentalization or semi-departmentalization in which teachers "trade" subjects.

C. Science is taught by a special science instructor who is a member of the school staff.

D. Science is taught by a visiting specialist who is employed by the district or school system.

E. Another plan entirely different from A to D above.

TABLE XXVII

PREFERRED PLANS CLASSIFIED BY SCIENCE COURSES TAKEN BY TEACHERS

Plan	Number of Professional Courses in Science: 1 No Course	2 One Course	3 Two Courses	4 3 or More Courses	5 Not Reported	Totals
A	48	60	40	41	75	264
B	19	27	24	29	17	116
C	17	42	20	28	12	119
D	3	3	3	0	1	10
E	4	0	0	0	1	5
Totals:	91	132	87	98	106	514
Percentage by Rows						
A	18.2	22.7	15.2	15.5	28.4	100.0
B	16.4	23.3	20.7	25.0	14.7	100.0
C	14.3	35.3	16.8	23.5	10.1	100.0
D	30.0	30.0	30.0	0.0	10.0	100.0
E	80.0	0.0	0.0	0.0	20.0	100.0
Totals:	17.7	25.7	16.9	19.1	20.6	100.0
Percentage by Total						
A	9.3	11.7	7.8	8.0	14.6	51.4
B	3.7	5.3	4.7	5.6	3.3	22.6
C	3.3	8.3	3.9	5.4	2.3	23.2
D	0.6	0.6	0.6	0.0	0.2	1.9
E	0.8	0.0	0.0	0.0	0.2	1.0
Totals:	17.7	25.7	16.9	19.1	20.6	100.0

Chi-square = 47.562 df = 16 $p < .01$ Significant relationship.

NOTE: Preferred plans are:

A. Science is taught by the classroom teacher.

B. Science is taught by a classroom teacher in the school as part of a system of departmentalization or semi-departmentalization in which teachers "trade" subjects.

C. Science is taught by a special science instructor who is a member of the school staff.

D. Science is taught by a visiting specialist who is employed by the district or school system.

E. Another plan entirely different from A to D above.

education courses that teachers have taken as part of their professional training.

The chi-square test of independence indicates that there is a significant relation between the preferred plans of teachers and the number of science courses that they have taken in their professional preparation. The percentages show that 17.7 per cent of the teachers surveyed have taken no courses, and 20.6 of the teachers did not report on this item. We are therefore uncertain of the preparation of 38.3 per cent of the teachers surveyed, regarding their preparation for teaching science. Of the remainder, 25.7 per cent have taken one course, 16.9 per cent two courses, and 19.1 per cent three or more courses.

Approximately 50 per cent of all teachers surveyed, prefer to use Plan A, and the remaining 50 per cent of teachers surveyed prefer to use Plan B or C. Only 2.9 per cent preferred to use a visiting specialist, or had made some other local arrangements that did not vary from some combination of Plans A, B, or C.

The Relation of Preferred Plan to the Type of Plan Being Used

Table XXVIII shows the preferred types of plans arranged according to the types of plans that are being used by teachers. The chi-square test of independence shows a significant relation between the type of plans

TABLE XXVIII

TEACHERS' PREFERRED PLANS CLASSIFIED BY ACTUAL PLANS BEING USED

Preferred Plan	Type of Plan Being Used A	B	C	D	E	Totals
A	257	6	0		1	264
B	93	17	6	No respondents are using this type of plan.	0	116
C	88	20	8		3	119
D	8	2	0		0	10
E	4	0	0		1	5
Totals:	450	45	14	(Science is taught by a visiting specialist employed by district or school system)	5	514
Percentage by Rows						
A	97.3	2.3	0.0		0.4	100.0
B	80.2	14.7	5.2		0.0	100.0
C	73.9	16.8	6.7		2.5	100.0
D	80.0	20.0	0.0		0.0	100.0
E	80.0	0.0	0.0		20.0	100.0
Totals:	87.5	8.8	2.7		1.0	100.0
Percentage by Totals						
A	50.0	1.2	0.0		0.2	51.4
B	18.1	3.3	1.2		0.0	22.6
C	17.1	3.9	1.6		0.6	23.2
D	1.6	0.4	0.0		0.0	1.9
E	0.8	0.0	0.0		0.2	1.0
Totals:	87.5	8.8	2.7		1.0	100.0

Chi-square = 75.070^{***} df = 12 $p < .001$ A very significant relationship.

NOTE: Types of plans being used are:

A. Science is taught by the classroom teacher.

B. Science is taught by a classroom teacher in the school as part of a system of departmentalization or semi-departmentalization, in which teachers "trade" subjects.

C. Science is taught by a special science instructor who is a member of the school staff.

D. Science is taught by a visiting specialist employed by the district or school system.

E. Another plan entirely different from those mentioned in A to D above.

preferred by teachers, and the type of plan they are using. Approximately 50 per cent of all teachers surveyed are teaching their own science and prefer to do so. Of the remainder, approximately 48 per cent of all teachers surveyed prefer some form of departmentalization or semi-departmentalization coupled with the use of a special science teacher who is a member of the school staff. The remaining two per cent favor a science specialist, or another plan entirely.

III. FEELINGS OF COMPETENCE IN TEACHING SCIENCE

One of the specific purposes of this study was to attempt to determine how competent teachers feel in teaching elementary school science, and to determine the relationship between expressed feelings of competence and the teacher variables of sex and professional preparation in science. These items are dealt with in this section and, in addition, the data is investigated to determine the relation between feelings of competence and the plans teachers are using, and the relation between feelings of competence and preferred plans.

Teachers' Expressed Feelings of Competence

In Part III of the teacher questionnaire, five levels of competence were listed, and teachers were asked to check the term which best describes their feelings of

competence at the grade level at which they teach. The five terms listed were:

1. Excellent
2. Good
3. Adequate
4. Below Average
5. Poor

Table XXIX shows the number of teachers and the percentage of teachers who checked each of the above levels of competency. The percentages indicate that approximately 6 per cent of the teachers feel inadequately prepared to teach all or part of the science program, 42 per cent feel adequately prepared and approximately 40 per cent feel above adequate in their ability to teach science. Approximately 13 per cent of teachers surveyed did not respond to this item.

The Relation of Feelings of Competence in Teaching Science to the Sex of the Teacher

Table XXX shows the level of competence checked by teachers, arranged according to the sex of the responding teachers. The chi-square test of independence shows a very significant difference. This indicates that there is a significant relationship between the degree of competence expressed by teachers, and the sex of teachers.

TABLE XXIX

TEACHERS' FEELINGS OF COMPETENCE
IN TEACHING SCIENCE

Level of Competence	Number of Teachers	Per Cent of Teachers
Excellent	23	4.47
Good	180	35.01
Adequate	216	42.02
Below Average	25	4.86
Poor	6	1.16
Not Reported	64	12.45
Totals:	514	99.97

TABLE XXX

EXPRESSED LEVEL OF COMPETENCE CLASSIFIED BY SEX OF TEACHERS

Level of Competence	1 Male	2 Female	Totals
Excellent	14	9	23
Good	37	143	180
Adequate	15	201	216
Below Average	1	24	25
Poor	1	5	6
Not Reported	42	22	64
Totals:	110	404	514
Percentage by Rows			
Excellent	60.9	39.1	100.0
Good	20.6	79.4	100.0
Adequate	6.9	93.1	100.0
Below Average	4.0	96.0	100.0
Poor	16.7	83.3	100.0
Not Reported	65.6	34.4	100.0
Totals:	21.4	78.6	100.0
Percentage by Total			
Excellent	2.7	1.8	4.5
Good	7.2	27.8	35.0
Adequate	2.9	39.1	42.0
Below Average	0.2	4.7	4.9
Poor	0.2	1.0	1.2
Not Reported	8.2	4.3	12.5
Totals:	21.4	78.6	100.0

Chi-square = 127.207** df = $p < .01$ Very significant.

The percentages show that almost twice as many males as females express as excellent, their level of competence; that almost more than four times as many females express their level of competence as good, than do the males; and that females express their level of competence as average, almost nineteen times as often as do the males. However, nearly five times as many females as males express competence as, below average.

Twice as many males as females failed to respond to this item. Generally, females feel more competent to teach science in the elementary school, than do male teachers.

The Relation of Feelings of Competence in Teaching Elementary Science to the Amount of Professional Preparation Teachers have Taken for Teaching Science

Table XXXI shows the level of competence marked by responding teachers, arranged according to the number of professional science courses teachers have taken.

The chi-square test of independence shows a significant difference. This indicates that the degree of competence expressed by teachers is related to the number of professional courses they have taken in science. The percentages indicate that the more professional science courses teachers have taken as part of their teacher preparation, the more competent they tend to

TABLE XXXI

EXPRESSED LEVEL OF COMPETENCE CLASSIFIED BY SCIENCE COURSES TAKEN BY TEACHERS

Level of Competence	Number of Professional Courses in Science: No Courses	One Course	Two Courses	3 or More Courses	Not Reported	Totals
Excellent	4	4	2	10	3	23
Good	32	34	31	42	41	180
Adequate	37	77	38	18	46	216
Below Average	7	8	0	4	6	25
Poor	2	0	2	1	1	6
Not Reported	9	9	14	23	9	64
Totals:	91	132	87	98	106	514

Percentage by Rows

Excellent	17.4	17.4	8.7	43.5	13.0	100.0
Good	17.8	18.9	17.2	23.3	22.8	100.0
Adequate	17.1	35.6	17.6	8.3	21.3	100.0
Below Average	28.0	32.0	0.0	16.0	24.0	100.0
Poor	33.3	0.0	33.3	16.7	16.7	100.0
Not Reported	14.1	14.1	21.9	35.9	14.1	100.0
Totals:	17.7	25.7	16.9	19.1	20.6	100.0

Percentage by Total

Excellent	0.8	0.8	0.4	1.9	0.6	4.5
Good	6.2	6.6	6.0	8.2	8.0	35.0
Adequate	7.2	15.0	7.4	3.5	8.9	42.0
Below Average	1.4	1.6	0.0	0.8	1.2	4.9
Poor	0.4	0.0	0.4	0.2	0.2	1.2
Not Reported	1.8	1.8	2.7	4.5	1.8	12.5
Totals:	17.7	25.7	16.9	19.1	20.6	100.0

Chi-square = 61.710** df = 20 $p < .01$. Significant relationship.

feel in teaching science. An exception noted, was five respondents with three or more courses in science preparation, felt below average in their level of competence. Of additional concern to the investigator, was the 20.6 per cent of respondents who did not reply to this part of the questionnaire.

The Relation of Feelings of Competence in Teaching Elementary Science to the Types of Plans Teachers are Using

Table XXXII shows the level of competence marked by teachers, arranged according to the types of plans teachers are using.

The chi-square test of independence shows a significant difference. This indicates that the degree of competence expressed by teachers is related to the type of plan they are using for instruction in science. The percentages indicate that teachers who feel competent in teaching most or all of the science program, are more likely to be teaching science to their own classes. Conversely, the majority of teachers surveyed who may feel inadequate in teaching science, were more likely to have science taught to their class by another staff member, (62.5 per cent) or to be part of a system of departmentalization or semi-departmentalization in which teachers "trade " subjects (9.3 per cent)

TABLE XXXII

EXPRESSED LEVEL OF COMPETENCE CLASSIFIED BY THE TYPES OF PLANS TEACHERS ARE USING

Level of Competence	Type of Plan Being Used A	B	C	D	E	Totals
Excellent	11	1	11	0		23
Good	57	18	104	1	No	180
Adequate	43	18	154	1	respondents	216
Below Average	4	8	12	1		25
Poor	2	0	3	1	replied	6
Not Reported	22	3	37	2	in this	64
Totals:	139	48	321	6	category	514
Percentage by Rows						
Excellent	47.8	4.3	47.8	0.0	- -	100.0
Good	31.7	10.0	57.8	0.6	- -	100.0
Adequate	19.9	8.3	71.3	0.5	- -	100.0
Below Average	16.0	32.0	48.0	4.0	- -	100.0
Poor	33.3	0.0	50.0	16.7	- -	100.0
Not Reported	34.4	4.7	57.8	3.1	- -	100.0
Totals:	27.0	9.3	62.5	1.2	- -	100.0
Percentage by Total						
Excellent	2.1	0.2	2.1	0.0	- -	4.5
Good	11.1	3.5	20.2	0.2	- -	35.0
Adequate	8.4	3.5	30.0	0.2	- -	42.0
Below Average	0.8	1.6	2.3	0.2	- -	4.9
Poor	0.4	0.0	0.6	0.2	- -	1.2
Not Reported	4.3	0.6	7.2	0.4	- -	12.5
Totals:	27.0	9.3	62.5	1.2	- -	100.0

Chi-square = 51.633** df = 15 $p < .01$. Significant.

NOTE: Types of plans being used by teachers were:

A. Science is taught by the classroom teacher.

B. Science is taught by a classroom teacher in the school as part of a system of departmentalization or semi-departmentalization in which teachers "trade" subjects.

C. Science is taught by a special science instructor who is a member of the school staff.

D. Science is taught by a visiting specialist employed by the district or school system.

E. Another plan entirely different from those mentioned in A to D above.

The Relation of Feelings of Competence in Teaching Elementary Science to the Types of Plans Preferred by Teachers

Table XXXIII shows the level of competence marked by teachers, arranged according to the types of plans teachers prefer for instruction in science.

The chi-square test of independence shows a significant difference (Table XXXIII). This indicates that the degree of competence expressed by teachers is related to the types of plans that teachers prefer for instruction in science. The percentages of the total show that approximately 12 per cent of those who prefer to have science taught by the classroom teacher, are teachers who feel competent in teaching most, or all, of the science program. Approximately 8 per cent of the teachers who prefer a system of departmentalization or semi-departmentalization, and 62 per cent of those who prefer to have science taught by a special science instructor in the schools, are teachers who feel competent in teaching most, or all, of the science program.

IV. COURSES OF STUDY IN TEACHING SCIENCE

This section will deal with the various courses of study available to the teachers of elementary science, in the province of Alberta, and will compare these 'course of study plans' with the variable of location.

TABLE XXXIII

EXPRESSED LEVEL OF COMPETENCE CLASSIFIED BY THE TYPES OF PLANS TEACHERS PREFER

Level of Competence	Preferred Organization A	B	C	D	E	Totals
Excellent	4	2	17	0	0	23
Good	30	24	126	0	0	180
Adequate	27	15	174	0	0	216
Below Average	4	1	20	0	0	25
Poor	1	0	4	0	1	6
Not Reported	15	17	26	5	1	64
Totals:	81	59	367	5	2	514
Percentage by Rows						
Excellent	17.4	8.7	73.9	0.0	0.0	100.0
Good	16.7	13.3	70.0	0.0	0.0	100.0
Adequate	12.5	6.9	80.6	0.0	0.0	100.0
Below Average	16.0	4.0	80.0	0.0	0.0	100.0
Poor	16.7	0.0	66.7	0.0	16.7	100.0
Not Reported	23.4	26.6	40.6	7.8	1.6	100.0
Totals:	15.8	11.5	71.4	1.0	0.4	100.0
Percentage by Total						
Excellent	0.8	0.4	3.3	0.0	0.0	4.5
Good	5.8	4.7	24.5	0.0	0.0	35.0
Adequate	5.3	2.9	33.9	0.0	0.0	42.0
Below Average	0.8	0.2	3.9	0.0	0.0	4.9
Poor	0.2	0.0	0.8	0.0	0.2	1.2
Not Reported	2.9	3.3	5.1	1.0	0.2	12.5
Totals:	15.8	11.5	71.4	1.0	0.4	100.0

Chi-square = 114.521** df = 20 $p < .01$. Very significant.

NOTE: Types of plans preferred by teachers were:

A. Science taught by the classroom teacher.

B. Science taught by a classroom teacher in the school as part of a system of departmentalization or semi-departmentalization in which teachers "trade" subjects.

C. Science is taught by a special science instructor who is a member of the school staff.

D. Science is taught by a visiting specialist who is employed by the district or school system.

E. Another plan entirely different from those mentioned in A to D above.

Type of Course of Study Used by Teachers

In Part III of the teacher questionnaire, teachers were asked to indicate what course of study plan was being followed in their classroom in teaching science. The alternative plans were:

A. A course set out in Provincial Bulletin IIb.
B. A course prepared locally for your district.
C. A course as outlined in one of the authorized series of textbooks.
D. A course selected according to the interests of your class.
E. No formal course of study.
F. Other.

The information from this part of the questionnaire is tabulated and presented in Table XXXIV.

The chi-square test of independence shows a significant difference. This indicates that there was a significant relation between the course of study chosen and the location of the school. The percentages indicated that 71.6 per cent of teachers surveyed, use a course of study as outlined in the Provincial Science Bulletin IIb; 6.4 per cent use a course of study prepared locally; 6.8 per cent follow a course as outlined in one of the authorized series of textbooks; and 10.5 per cent select a course according to the interests of their class. Two per cent use no formal course of study, while another 2.5 per cent

TABLE XXXIV

SCIENCE COURSES OF STUDY IN ELEMENTARY CLASSROOMS AS REPORTED BY TEACHERS

	Source of Curriculum Guide	Urban Teachers	Rural Teachers	Totals
A.	A course set out in Provincial Bulletin IIb	202	166	368
B.	A course prepared locally for your district	28	5	33
C.	A course as outlined in one of the authorized series	17	18	35
D.	A course selected according to the interests of your class	43	11	54
E.	No formal course of study	8	3	11
F.	Other	6	7	13
	Totals:	304	210	514
	Percentage by Rows			
A	1	54.9	45.1	100.0
B	2	84.8	15.2	100.0
C	3	48.6	51.4	100.0
D	4	79.6	20.4	100.0
E	5	72.7	27.3	100.0
F	6	46.2	53.8	100.0
	Totals:	59.1	40.9	100.0
	Percentage by Total			
A	1	39.3	32.3	76.6
B	2	5.4	1.0	6.4
C	3	3.3	3.5	6.8
D	4	8.4	2.1	10.5
E	5	1.6	0.6	2.1
F	6	1.2	1.4	2.5
	Totals:	59.1	40.9	100.0

Chi-square = 24.523 df = 5 $p < .01$. Significant relationship.

use a course outline that is a composite of all plans offered. Urban teachers use a course prepared locally with five times the frequency that rural teachers use a locally prepared course of study in science.

V. CONTRIBUTIONS THAT SCIENCE CAN MAKE TO THE OBJECTIVES OF THE ELEMENTARY SCHOOL PROGRAM

In order to place science in a perspective with other subjects on the elementary school curriculum the teachers surveyed were asked to rate science as a subject. The rating of science will be compared with the variable of location (urban-rural).

Teachers' Rating of Science

In Part III of the teacher questionnaire, teachers were asked to indicate their rating of science as to the contribution it can make to the objectives of the total elementary school program. The alternative choices were:

1. Excellent
2. Very good
3. Good
4. Fair
5. Poor

The information from this part of the questionnaire is tabulated and presented in Table XXXV.

The chi-square test of independence showed a significant difference. This indicates that there was a

TABLE XXXV

TEACHERS' RATING OF SCIENCE AS TO THE CONTRIBUTION IT CAN MAKE TO THE OBJECTIVES OF THE TOTAL ELEMENTARY SCHOOL PROGRAM

	Item	Location: Urban Teachers	Location: Rural Teachers	Totals
1	Excellent	67	29	96
2	Very Good	125	69	194
3	Good	98	100	198
4	Fair	7	9	16
5	Poor (Not signified by any teacher, therefore not included in table)			
6	Not reported	7	3	10
	Totals:	304	210	514
	Percentage by Rows			
1	Excellent	69.8	30.2	100.0
2	Very Good	64.4	35.6	100.0
3	Good	49.5	50.5	100.0
4	Fair	43.8	56.3	100.0
5	Poor (Not included)	-	-	-
6	Not reported	70.0	30.0	100.0
	Totals:	59.1	40.9	100.0
	Percentage by Total			
1	Excellent	13.0	5.6	18.7
2	Very Good	24.3	13.4	37.7
3	Good	19.1	19.5	38.5
4	Fair	1.4	1.8	3.1
5	Poor (Not included)	-	-	-
6	Not reported	1.4	0.6	1.9
	Totals:	59.1	40.9	100.0

Chi-square = 16.436 df = 4 $p < .01$. Significant relationship.

significant relation between the rating of science as to the contribution it can make to the objectives of the total elementary school program, and the location of the school. The percentages indicate that 18.7 per cent of teachers surveyed rate science for its contributions to the objectives of the elementary school program, as excellent; 37.7 per cent as very good; 38.5 per cent as good; 3.1 per cent as fair; and no one rates its contributions as poor. Approximately twice as many urban teachers rate the contributions of science as excellent or very good, as do the rural teachers. Both urban and rural teachers rate it equally in the category "good."

VI. INTEGRATION OF SCIENCE

Science in the elementary school has been traditionally integrated with other subject matter in the elementary school curriculum. There has been a tendency in recent years to extract science from this integration, and allow it to stand as a separate subject. Principals surveyed were asked to indicate the method of integration, if any, of science in their school.

Principals' Assessment of the Integration of Science

In Part II of the principals questionnaire, principals were asked if science was integrated with other subject areas, and to indicate the subject with

TABLE XXXVI

INTEGRATION OF SCIENCE WITH OTHER SUBJECT MATTER

	Item	Location: Urban Principals	Location: Rural Principals	Totals
1	Mathematics - Enterprise	1	0	1
2	Enterprise-Language	16	13	29
3	Reading	2	0	2
4	Language (Not signified)	-	-	-
5	Health	2	2	4
6	Not reported	4	0	4
7	Art (Not signified)	-	-	-
8	No subjects	0	6	6
9	All subjects	0	2	2
	Totals:	25	23	48
	Percentage by Rows			
1		100.0	0.0	100.0
2		55.2	44.8	100.0
3		100.0	0.0	100.0
4	Not signified	-	-	-
5		50.0	50.0	100.0
6		100.0	0.0	100.0
7	Not signified	-	-	-
8		0.0	100.0	100.0
9		0.0	100.0	100.0
	Totals:	52.1	47.9	100.0
	Percentage by Total			
1		2.1	0.0	2.1
2		33.3	27.1	60.4
3		4.2	0.0	4.2
4	Not signified	-	-	-
5		4.2	4.2	8.3
6		8.3	0.0	8.3
7	Not signified	-	-	-
8		0.0	12.5	12.5
9		0.0	4.2	4.2
	Totals:	52.1	47.9	100.0

Chi-square = 15.253 df = 6 $.01 < p < .02$. Significant relationship.

which science is integrated. The alternative choices were not supplied in the questionnaire.

The information from this part of the questionnaire is tabulated and presented in Table XXXVI.

In Table XXXVI the chi-square test of independence shows a significant difference. This indicates that there was a significant relation between the integration of science with other subject matter on the elementary school curriculum, and the location of the school. The percentages indicate that 2.1 per cent of urban principals integrate science with mathematics, whereas rural principals do not; 60.4 per cent of all principals surveyed integrate science with enterprise activities; 4.2 per cent of urban principals integrate science with reading; 8.3 per cent of all principals do not integrate science; and 4.2 per cent of rural principals integrate science with all subjects; 8.3 per cent of urban principals did not report on this item in the principals questionnaire.

VII. EQUIPMENT AND FACILITIES TO ACCOMMODATE THE ELEMENTARY SCIENCE PROGRAM

One of the purposes of this study was to determine to what extent the elementary classrooms of Alberta have the equipment and facilities to accommodate the science program. Equipment rating and the method of obtaining

TABLE XXXVII

FACILITIES AND EQUIPMENT FOR SCIENCE INSTRUCTION

Item	Yes	No	Totals
1. Separate Room	14	34	48
2. Tables	33	15	48
3. Portable Science Unit	22	16	48
4. Sink and Water Supplies	23	25	48
5. Other	13	35	48

science equipment will also be related to the variable location.

Various Equipment and Facilities to Accommodate the Science Program

In Part III of the principals' questionnaire five items of facilities were listed, they wer:

1. A separate science room.
2. Tables for science demonstration.
3. Portable science demonstration unit.
4. Sink and water supply in rooms.
5. Other facilities.

Table XXXVII shows the number of these facilities available as reported by the forty-eight principals surveyed.

In Part III of the principals questionnaire seven items relating to Audio Visual facilities were listed. They were:

1. An overhead projector
2. A filmstrip projector
3. A 16 mm. film projector
4. Projector screens
5. Models (plastic, metal, cardboard, etc.)
6. Transparaencies
7. Other facilities

Table XXXVIII summaries the number of these facilities available, as reported by the forty-eight principals surveyed.

TABLE XXXVIII

AUDIO-VISUAL FACILITIES OR EQUIPMENT FOR SCIENCE INSTRUCTION

	Item	Yes	No	Total
1	Overhead projector	39	9	48
2	Filmstrip projector	47	1	48
3	16 mm. film projector	47	1	48
4	Projection screens	47	1	48
5	Models (plastic, metal cardboard, etc.)	20	28	48
6	Transparencies	21	27	48
7	Other facilities	14	34	48

In Part III of the principals questionnaire five items relating to available printed materials for science instruction were listed. They were:

1. One authorized series of science texts for each grade.
2. More than one authorized series of texts.
3. Additional series of science texts, not authorized but used for enrichment.

4. Science charts (for example, "The Earth's Crust").

5. Other materials.

Table XXXIX summaries the number of these facilities as reported by the forty-eight principals surveyed.

TABLE XXXIX

AVAILABLE PRINTED MATERIALS FOR SCIENCE INSTRUCTION

	Item	Yes	No	Totals
1	One authorized series of science texts for each grade	30	18	48
2	More than one authorized series of texts	37	11	48
3	Additional series of science texts, not authorized but used for enrichment	38	10	48
4	Science charts	31	17	48
5	Other materials	8	40	48

Science Equipment Rating of Alberta Elementary Schools

In Part III of the principals questionnaire, principals were asked to indicate the amount of science equipment available for science instruction, as compared with the amount noted and listed in Provincial Bulletin IIb. This amount is printed and attached as Appendix C. The alternative amounts listed in the principals questionnaire were:

1. More than amount noted in Bulletin IIb
2. The amount noted in Bulletin IIb
3. One-half the amount noted in Bulletin IIb
4. One-quarter the amount noted in Bulletin IIb
5. Very little, if any, of the amount noted in Bulletin IIb

Table XL shows the equipment rating of schools using Bulletin IIb as a guide, compared with the location of the principal's school.

The chi-square test of independence shows no significant difference. This indicates that there is no significant relation between the science equipment rating of schools and their location. It is noted, however, that the majority of the schools in the sample surveyed, are well equipped using as a comparison the amounts noted in Bulletin IIb.

TABLE XL

EQUIPMENT RATING OF SCHOOL USING PROVINCIAL SCIENCE BULLETIN IIb AS A GUIDE

	Item	Location: Urban Principals	Location: Rural Principals	Totals
1	More than amount in Bulletin IIb	14	8	22
2	Same amount as in Bulletin IIb	8	4	12
3	One-half amount in Bulletin IIb	2	7	9
4	One-quarter amount in Bulletin IIb	0	3	3
5	Very little, if any, of amount in Bulletin IIb	0	1	1
6	Not reported	1	0	1
	Totals:	25	23	48
	Percentage by Rows			
1	More than amount	63.6	36.4	100.0
2	Same amount	66.7	33.3	100.0
3	One-half amount	22.2	77.8	100.0
4	One-quarter amount	0.0	100.0	100.0
5	Very little, if any	0.0	100.0	100.0
6	Not reported	100.0	0.0	100.0
	Totals:	52.1	47.9	100.0
	Percentage by Total			
1	More than amount	29.2	16.7	45.0
2	Same amount	16.7	8.3	24.0
3	One-half amount	4.2	14.6	18.8
4	One-quarter amount	0.0	6.3	6.3
5	Very little	0.0	2.1	2.1
6	Not reported	2.1	0.0	2.1
	Totals:	52.1	47.9	100.0

Chi-square = 10.683 df = 5 $.05 < p < .10$. No significance.

The Obtaining of Science Equipment for Daily Use

In Part III of the principals questionnaire, principals were asked to indicate how the science equipment used in the elementary school is obtained for daily classroom use. The alternative plans were:

1. Borrowed from the Junior High School.

2. Obtained from a science storage room or cupboard in the school.

3. Obtained from storage in the classroom where science is taught.

4. Requisitioned from the school district for a specified period of time.

5. Not reported.

Table XLI shows the alternative plans arranged according to the location of the school.

The chi-square test of independence shows no significant difference. This indicates that there is no significant relation between the method of obtaining science equipment for daily use and the location of the principal's school.

VIII. SUGGESTIONS FOR IMPROVEMENT OF THE ELEMENTARY SCIENCE PROGRAM

In Part III of the principal and teacher questionnaire, the last item requiring a reply from the respondents, was their comments and suggestions as to how the

TABLE XLI

METHOD OF OBTAINING SCIENCE EQUIPMENT FOR DAILY USE

	Item	Location: Urban Principals	Location: Rural Principals	Totals
1	Borrowed from Jr. High School	2	2	4
2	Obtained from science storage or cupboard in school	20	16	36
3	Obtained from storage in the classroom where science is taught	2	5	7
4	Requisitioned from school district for specified time	1	0	1
5	Not reported	-	-	-
	Totals:	25	23	48
	Percentage by Rows			
1		50.0	50.0	100.0
2		55.6	44.4	100.0
3		28.6	71.4	100.0
4		100.0	0.0	100.0
5	Not reported	-	-	-
	Totals:	52.1	47.9	100.0
	Percentage by Total			
1		4.2	4.2	8.3
2		41.7	33.3	75.0
3		4.2	10.4	14.6
4		2.1	0.0	2.1
5	Not reported	-	-	-
	Totals:	52.1	47.9	100.0

Chi-square = 2.651 df = 3 $.30 < p < .50$. Not significant.

science program might be improved in their school.

The format employed in the questionnaires to gather information was too open. The item should have been partially structured by the investigator, in order that the process of transferring the information to I.B.M. cards would have been more precise. Item analysis was found to be impossible.

Many of the suggestions were concerned with items presented earlier in the questionnaire, for it seemed to provide a guide for their suggestions.

Approximately 65 per cent of all principals and teachers surveyed, contributed suggestions for the improvement of the elementary science program.

Their suggestions for improvement fell into six major categories, noted below:

1. Physical facilities
2. All types of teaching materials and equipment
3. Organization of the science program
4. Teacher qualifications
5. Science fairs, workshops, and seminars
6. Criticisms and problems

Sixty-three per cent of the sample surveyed feel that the science program could be enhanced by the provision of better physical facilities, a science room and science storage cupboards were noted with approximately 20 per cent frequency.

Fifty-one per cent noted a shortage of all types of science teaching materials, science reference books, science leisure reading material, science demonstration supplies, student science kits, and audio-visual equipment.

Approximately twenty-five per cent were concerned with the organization of the science program in their school and classroom. Suggestions on departmentalization, team teaching, resident co-ordinators of science, and science consultants were voiced. Provision for more time per day and/or week, were a major concern. Greater specialization of staff members was suggested as a major factor in effecting a better science program.

The improvement of teacher qualifications was mentioned by more than twenty per cent of the principals and teachers surveyed.

Enrichment of the science program to include science fairs, student and teacher workshops, and seminars was noted in approximately twenty per cent of the questionnaires returned.

Finally, the survey noted some major criticisms and problems in the elementary science program. In approximately two per cent of the questionnaires returned the teachers noted the improper use of text book materials, the overlapping of the curriculum of science throughout

the grades, and the large classroom enrollments as problems yet to be solved.

IX. SUMMARY OF FINDINGS

This study endeavored to determine: (1) the practice and organizational plans that principals and teachers use for the teaching of science in the elementary schools of the province of Alberta; (2) the practice and organizational plans that principals and teachers prefer for the teaching of science; (3) an indication of teachers' feelings of competence in teaching science; (4) what courses of study were being followed in science education; (5) an indication of respondents' estimates as to the contribution science can make to the objectives of the total elementary science school program; (6) the degree of integrating of science with other subject areas on the elementary school curriculum; and (7) to what extent the elementary classrooms of Alberta have the equipment and facilities to accommodate the elementary science program. In addition, the study compared the relationship between the above factors and the variables of size of school, location of school, and the teacher characteristics of sex and amount of professional preparation for teaching elementary school science.

The remainder of Chapter IV summaries the more

important findings of this study.

Present Practice and Organizational Plans for Teaching Elementary School Science

1. Urban teachers who are teaching science to their own classes comprise 84.9 per cent. Departmentalization or semi-departmentalization accounted for 13.2 per cent of the practice of Alberta urban teachers, the remaining 1.3 per cent use some combination of the two plans noted above.

There was no significant relationship between the manner in which science was being taught and the grade level, in the rural schools of Alberta. It is noted, however, that 91.4 per cent of rural teachers teach science to their own classes.

2. The chi-square test of independence shows a very significant relationship between grade level taught, and how the classroom is organized for the teaching of science in an urban classroom, but there is no such significant relationship in a rural elementary science class.

In grades one and two, urban teachers usually completely, or partially, integrate science with other subjects but that in grades 4, 5, and 6 they appear to teach it as a separate subject. Rural science teachers prefer to teach science throughout the grades as a

separate subject, but with appropriate integration and correlation with other subjects.

3. There is a significant relationship between the type of plan used in teaching science and the sex of the teacher, if the teacher is female. No such significant relationship exists if the science teacher is a male.

Percentages indicate that 96.4 per cent of male teachers who are teaching science are assigned to grades 4, 5, or 6 and that in those grades they are likely to be teaching their own science, and be part of a system of departmentalization or semi-departmentalization; 73.3 per cent of female teachers are teaching in grades one to four, and in those grades they are teaching their own science.

4. Approximately 18 per cent of the teachers surveyed have taken no courses in science as part of their professional training; 36 per cent have taken two or more courses. There is a significant relationship between teacher preparation for teaching science and the location of the school in which the teacher is teaching. Urban teachers appear to have taken more professional training in science than rural teachers have. There is also no significant relationship between the number of science courses teachers have taken and the type of plan used for teaching science.

5. Percentages indicate that there is approximately equal use made of some form of departmentalization or semi-departmentalization throughout all grades in the elementary school. However, the greatest application is being made at the grade six level. The chi-square test of independence shows that there is no significant difference between grade levels, and the use of departmentalized or semi-departmentalized forms of organization for the science program. There is also no significant difference between urban and rural schools in regard to the type of organizational plans that teachers are using for instruction in science; nor is there any significant relationship between size of school and the use that is being made of departmentalization or semi-departmentalization, for instruction in science. Finally, there is no significant relationship between size of school and the type of organizational plan teachers were using.

6. Twenty-six of the 514 teachers surveyed, were teaching science to two or more classes. There is a very significant relationship between the number of science classes teachers teach and the sex of the teacher. Percentages indicate that female teachers are teaching slightly more science classes than are male teachers.

There is also a very significant relationship

between teachers professional preparation, and the number of classes of science they are instructing. Percentages show that teachers with more professional preparation in science, tend to be teaching more science in the elementary schools surveyed.

Organizational Plans Favored by Principals and Teachers*

1. Plans favored by principals and teachers varied, according to the grade level at which science was being taught. Applying the chi-square test of independence to the plans favored by the principals and by the teachers, it was found that in each case there is a significant difference between grade levels and the choice of plans.

Almost all principals surveyed taught science in grade six and preferred Plan A. Percentages show that teachers of all grades tend to favor Plan A, but that its use gradually diminishes from grades one to six. In grades four to six, teachers prefer Plan B or C or some form of plans of B and C combined. Of the teachers surveyed, 1.1 per cent had created a plan of their own but it was similar to Plan A, when assessed by the investigator.

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*The alternative organizational plans mentioned below are listed in the principal and teacher questionnaires, in Appendices B and C.

2. In the sample studied, there was a significant relationship between the organizational plans favored by teachers and the sex of the teachers. Percentages indicated that approximately fifty per cent of all teachers surveyed, male and female, prefer to teach their own science; that approximately fifty per cent prefer to have science taught in some form of departmentalization or semi-departmentalization; and that slightly more than twenty per cent prefer to have science taught by a special science teacher who is a member of the school staff. Approximately two per cent favor science being taught by a visiting specialist.

Male teachers seem to prefer that science be taught by a special science instructor, and favor a form of departmentalization or semi-departmentalization.

3. There was a significant relationship between the preferred plans of teachers, and the number of science courses they had taken in their professional preparation. Of the teachers surveyed, 17.7 per cent have taken no courses; 20.6 per cent of the sample surveyed did not report on this item; of the remainder, 25.7 per cent have taken one course; 16.9 per cent two courses; and 19.1 per cent three or more courses.

4. Approximately fifty per cent of all teachers surveyed, prefer to use Plan A and the remaining fifty per cent Plan B or C; only 2.9 per cent favor a visiting

specialist, or some combination of Plans A, B, C, and D.

5. The chi-square test of independence shows a significant relationship between the types of plans teachers prefer for teaching elementary science, and the types of plans they are using. Approximately fifty per cent of all teachers surveyed, are teaching their own science and prefer to do so. Of the remainder, approximately forty-eight per cent of all teachers surveyed prefer some form of departmentalization or semi-departmentalization, coupled with the use of a special science teacher who is a member of the school staff. Teachers surveyed are planning the practice of teaching elementary science in this manner.

Feelings of Competence in Teaching Science

1. Approximately six per cent of teachers surveyed feel inadequately prepared to teach all or part of the science program; forty per cent feel good to excellent in their ability to teach science. Approximately thirteen per cent of teachers did not respond to this item.

2. There is a significant relationship between the degree of competence expressed by teachers and the sex of the teachers. The percentages show that almost twice as many males express as excellent, their level of competence. Females express their level of competence

as good, almost four times more frequently than do the males. Females express their level of competence as average, almost nineteen times as often as do the males. However, nearly five times as many females as males express competence as below average.

3. There is a significant relationship between the degree of competence expressed by the responding teachers, and the number of professional science courses that they have taken. The more professional preparation teachers had in science, the more competent they tended to feel in teaching elementary school science.

4. There is a significant relationship between the degree of competence expressed by the surveyed teachers, and the type of plan these teachers were using for instruction in elementary science. The percentages indicate that teachers who feel competent in teaching most, or all, of the science program, are more likely to be teaching science to their own class; while those who felt inadequate in teaching science were more likely to have science taught to their class by another staff member (62.5 per cent) or be part of a system of departmentalization or semi-departmentalization in which teachers "trade" subjects. 9.3 per cent were in this latter category.

5. There is a significant relationship between

the degree of competence in teaching science and the types of plans preferred by teachers, for instruction in science in the elementary school. Approximately twelve per cent of those who prefer to have science taught by the classroom teacher, are teachers who feel competent in teaching most, or all, of the science program. Approximately eight per cent of the teachers who prefer a system of departmentalization or semi-departmentalization, and sixty-two per cent of those who prefer to have science taught by a special science instructor in the schools, are those who feel competent in teaching most, or all, of the science program.

Courses of Study in Teaching Science

1. There was a significant relationship between the course of study chosen, and the location of the school (urban; rural).

The percentages indicate that 71.6 per cent of teachers surveyed use a course of study as outlined in Provincial Science Bulletin IIb, 6.4 per cent use a course of study prepared locally; 6.2 per cent follow a course as outlined in one of the authorized textbook series; and 10.5 per cent select a course according to the interests of their class. Urban teachers use a course of study in elementary school science, prepared locally, with five times the frequency of rural teachers.

Contributions that Science can make to the Objectives of the Elementary School Program

1. There was a significant relationship between the rating of science, as to the contributions it can make to the objectives of the total elementary program, and the location of the school; 18.7 per cent assign the rating as excellent; 37.7 per cent as very good; 38.5 per cent as good; 3.1 per cent as fair, and no one rated its contributions as poor. Approximately twice as many urban teachers rate the contributions of science as excellent or very good, as do the rural teachers. Both urban and rural teachers rate it equally in the catefory, good.

Integration of Science with the Total Elementary Curriculum

1. Principals were asked if science was integrated with other subject areas on the elementary curriculum. There was a significant relationship between the integration of science with other subject matter on the elementary school curriculum, and the location of the school (urban; rural). The percentages indicated that 2.1 per cent of urban principals integrate science with mathematics whereas rural principals do not. 60.4 per cent of all principals surveyed integrate science with enterprise activities; 4.2 per cent of urban principals

integrate science with health; 12.5 per cent of rural principals do not integrate science with any subject; and 4.2 per cent of rural principals integrate science with all subjects.

Equipment and Facilities to Accommodate the Elementary Science Program

1. Of the forty-eight principals surveyed fourteen had a separate science room, thirty-three science demonstration tables, twenty-two had portable science units, twenty-three had sinks and water supply in the classroom used for science, and thirteen principals had other building facilities in addition to those stipulated in the principal questionnaire.

2. In the area of audio-visual facilities the forty-eight principals reporting, noted the following equipment in their school: overhead projector, 39; filmstrip projector, 47; a 16 mm. film projector, 47; projection screens, 47; models (plastic, metal, cardboard) 20; transparencies for science instruction, 21; and fourteen reported other A/V facilities not stipulated on the survey instrument.

3. Items relating to available printed materials for science instruction were reported by the forty-eight principals surveyed. There were thirty schools using

one authorized series of science texts for each grade; thirty-seven schools using more than one series of texts; thirty-eight schools with additional series of science texts not authorized but used for enrichment of the science curriculum; thirty-one schools reported having science charts, and eight schools had additional printed materials not stipulated on the principal questionnaire.

4. Regarding the equipment rating of schools surveyed, using Provincial Science Bulletin IIb as a guide, there is no significant relationship between the science equipment rating of schools, and the variable location (urban;rural). It was noted that the majority of schools in the sample surveyed, appear to be well equipped using as a basis for comparison the amounts noted in Provincial Science Bulletin IIb.

5 Regarding the method of obtaining science equipment for daily use, there is no significant relation between the method of obtaining science equipment for daily use, and the location of the principal's school.

Suggestions for Improvement of the Science Program

Suggestions for improvement were contributed by sixty-five per cent of the principals and teachers in the survey sample. These suggestions resolved themselves

into six major categories. (1) Improvement of physical facilities for science instruction, 63 per cent; (2) Shortage of all types of teaching materials and equipment, 51 per cent; (3) The organization of the science program in their school, 25 per cent; (4) The improvement of teacher professional science qualifications, 20 per cent; (5) Enrichment of the science program to include science fairs, workshops, and seminars by 20 per cent; (6) Two per cent had specific criticisms relating to (a) the improper use of textbook materials, (b) the overlapping of the elementary school science curriculum with that of the junior high school, (c) large classroom enrollments as a factor in inadequate science instruction.

CHAPTER V

SUMMARY, CONCLUSIONS, AND RECOMMENDATIONS

Chapter five summarizes the purposes of this study and the procedures used in conducting the study. The limitations of the survey are noted, and the primary conclusions resulting from the findings are listed and discussed. The important implications of the study are discussed and several recommendations arising out of these implications are presented.

I. SUMMARY

The major purposes of this study were to determine: the practice and organizational plans that principals and teachers use for the teaching of science in the elementary schools of Alberta; the practice and organizational plans that principals and teachers prefer for the teaching of science; an indication of the extent of teachers' feelings of competence in teaching science; an indication of respondents' estimates as to the contribution science can make to the objectives of the total elementary school program; the degree of integration of science with other subject areas in the elementary school curriculum; and to what extent the elementary classrooms of Alberta have

the equipment and facilities to accommodate the elementary science program.

A further purpose was to compare the relationship between the above factors and the variables of size of school, location of school, and the teacher characteristics of sex, and amount of professional preparation for teaching elementary school science, and to determine if there were significant relationships.

In Chapter II the research on departmentalization and semi-departmentalization of instruction in elementary schools was reviewed. It accented the preference of teachers and administrators regarding departmentalization, research on elementary science text books and elementary science equipment was reviewed; research on preferred methods of teaching elementary science was assessed, as was the available research concerning the integration of the elementary science program with the entire school program, and finally, a review of research on the preparation of science teachers.

Information was gathered from the principals and teachers in the sample surveyed, by the use of a principal questionnaire and a teacher questionnaire. These questionnaires were constructed and distributed to a randomly selected sample of thirty urban schools, and thirty rural schools in the province of Alberta. Responses were received from forty-eight principals and

four hundred and sixty-six teachers. This represented an eighty per cent return from principals and an 84.4 per cent return from teachers. Two principals of school staffs submitting teacher returns were unable to complete their principal questionnaire. Thus lowering the percentage of principal questionnaire returns.

The information from the returned questionnaires was analyzed in Chapter IV, under the following headings:

1. Existing organizational plans for teaching science.

2. Preference in regard to organization for instruction in science.

3. Feelings of competence in teaching science.

4. Courses of study in teaching science.

5. Contributions that science can make to the objectives of the elementary school program.

6. Integration of science.

7. Equipment and facilities to accommodate the elementary science program.

8. Suggestions for improvement of the elementary science program.

A deliberate approach to the structuring of the principal and teacher questionnaires was made. It was intended that their form and design would provide the principals and teachers surveyed, with an opportunity

to indicate as clearly and accurately as possible the type of organization and practice that is being used in their schools, the type of organization and practice that they would prefer for use in their schools, and the degree to which they feel competent in teaching elementary school science. The structure of the questionnaire also allowed them to accurately respond to: courses of study being followed in teaching science; estimates of the contribution science can make to the objectives of the total elementary school program; the integration of science with other subjects on the elementary curriculum; and the equipment and facilities to accommodate the elementary science program in Alberta. In an attempt to minimize the discrepancies that might result due to different interpretations of some of the terms used in the questionnaires, the questionnaires were designed to provide checks on the validity of responses and to provide the researcher with an overall picture of the type of organization being used in the schools. Few adjustments were necessary and in general, the nature, degree, and precision of the information obtained from the principals and teachers surveyed provided substantial evidence to indicate the test-instruments were effective in design, and that they secured the desired information.

The procedures followed in the distribution and return of the questionnaires resulted in a fairly high percentage of returns from both principals and teachers. It was therefore, assumed that the teachers and principals participating in the study were representative of all principals and teachers in elementary schools of five rooms or larger, in the province of Alberta.

The chi-square test of independence coupled with the CROS-2 program for the 7040 computer, and the retention of percentages by row and column on all tables, seemed most appropriate for discovering the validity of differences between groups and sub-groups. If the number of respondents in any group or sub-group was considered relatively small, then either no conclusions have been made concerning the findings, or a cautious assessment and interpretation has been made.

In general, the format, type, and scope of the study and the methods employed, to collect and analyze the data, suggest that the findings reported should be reliable indicators of the factors studied concerning science instruction in the elementary schools of the Province of Alberta.

II. CONCLUSIONS

The primary conclusions that this research will support are presented and discussed under seven general

headings in this section. These conclusions are based on the information received from the forty-eight principals and the four hundred and sixty-six teachers who took part in this project. The conclusions apply to elementary schools in the province of Alberta, having five or more elementary classrooms in operation.

Organizational Plans and Practices Used for Instruction in Science in the Elementary Schools of Alberta

1. The majority of teachers in the elementary classrooms of Alberta are teaching their own science. In most of the cases where science is not being taught by the classroom teacher, some type of organizational arrangement is being effected whereby it is taught by another staff member. In very few of the cases where science is taught by another staff member, is this person a specially qualified science teacher. Many urban schools are using a type of departmentalization or semi-departmentalization to teach science; the rural schools do not seem to be following this pattern. Very little departmentalization or semi-departmentalization is being used in grades one to three, but its use increases in grades four to six.

2. Urban classroom organization in grades one to three seems to lend itself to the complete integration of science with other subject matter, but in

grades four to six, urban teachers strongly favor teaching science as a separate subject. Rural teachers prefer to teach science throughout the grades as a separate subject, but with appropriate integration and correlation.

3. There is a significant relationship between the type of plan used in teaching science and the sex of the teacher. There is a tendency for male teachers to be assigned to grades four to six, and that in those grades they are likely to be teaching their own science and be part of a system of departmentalization or semi-departmentalization. Most female teachers are teaching in grades one to three, and in those grades they are teaching their own science.

4. About one-fifth of the elementary teachers in Alberta have had no professional preparation for teaching science and slightly more than one-quarter have taken only one course in science, as part of their professional preparation. A third of the teachers in the elementary schools have taken two or more science courses during the period of their professional preparation. This means that there are relatively few teachers who could be considered well qualified to teach science in the elementary school. Urban teachers appear to have taken more professional training in

science than rural teachers.

5. There is no significant relationship between the number of science courses which teachers have taken and the type of plan used to teach science.

6. There is no significant relationship between grade levels and the use of departmentalized or semi-departmentalized forms of organization for the science program, or between urban and rural schools in regard to the type of organizational plans that teachers are using for instruction in science, nor is there any significant relationship between size of school and the use that is made of departmentalization or semi-departmentalization, nor is there a significant relationship between size of school and the type of organizational plan teachers are using to instruct elementary science.

7. There is a significant relationship between the number of science classes teachers teach and the sex of the teacher. Percentages indicate that female teachers are teaching science only to their own class with greater relative frequency than are the male teachers. Male teachers tend to teach science to their own class as well as to other classes under a system of departmentalization. It is indicated that the teachers with more professional training in science are teaching more science classes in the elementary schools surveyed. This indicates that the services of

qualified personnel are being utilized.

Organizational Plans Preferred by Principals and Teachers

1. Plans favored by principals and teachers varied according to the grade level at which science was being taught. There was a significant difference noted between grade levels and the choice of plans. The majority of principals favored having science taught by the classroom teacher in grades one to three, but prefer a system of departmentalization or semi-departmentalization in grades four to six. The teachers preferred to have science taught by the classroom teacher in all grades from one to six, with a small degree of departmentalization or semi-departmentalization in the upper grades. This means that except for grades one to three, most principals and teachers would like to have some type of organizational arrangement, whereby science was taught by another staff member who is more capable of giving instruction in science.

As most teachers are teaching their own science, and since this type of organization is not the kind preferred by most teachers, it seems reasonable to conclude that most teachers are not satisfied with the type of organization that they are presently

using for instruction in science.

2. There is a significant relationship between the organizational plans preferred by teachers and the sex of the teacher. Although the majority of both female and male teachers favor an organizational arrangement whereby science could be taught by someone in the school, other than the classroom teacher, a higher percentage of male teachers than of female teachers prefer this type of organization, with a fairly large number of female teachers preferring to have science taught by the classroom teacher. These differences are probably related to the fact that most male teachers are teaching in grades four to six, where a system of departmentalization or semi-departmentalization is more likely to be preferred, while most female teachers are teaching in grades one to three, where it is often felt that science should be taught by the classroom teacher.

3. There is a significant relationship between the preferred plan of teaching science, and the number of professional science courses teachers have taken. The more science courses teachers have taken, the more they prefer to teach science; either to their own class, or within a system of departmentalization or semi-departmentalization, where they are responsible for instruction in science to more classes than their own.

4. There is also a significant relationship between the type of organization plans preferred by teachers and the type of plan that teachers are actually using. Approximately one-half of the teachers are teaching their own science and prefer to do so. The remaining half prefer some form of departmentalization or semi-departmentalization coupled with the use of a special resident science teacher. It is encouraging to note that the teachers surveyed, prefer planning the practice of teaching elementary science in this manner. It would, however, not be correct to assume that most teachers prefer the type of organizational plans they are presently using; since, as we noted previously, the majority of teachers prefer a type of organization whereby science may be taught by another staff member and this type of organization is not predominantly practiced in Alberta schools.

Teachers' Feelings of Competence in Teaching Science

1. Approximately ten per cent of the teachers in Alberta's elementary schools feel inadequate in teaching most, or all, of the elementary science program.

2. There is a significant relationship between the degree of competence expressed and the sex of the teachers. Males feel more competent than females in the ratio of two to one, although it must be noted that

females express the level of their competence as average, almost nineteen times as frequently as do the males.

3. There is a significant relationship between teachers' feelings of competence in teaching science and the amount of professional preparation that teachers have taken in science. The more professional preparation teachers had in science, the more competent they tended to feel in teaching elementary school science.

4. There is a tendency for teachers who feel competent in teaching elementary school science, to be teaching this subject to their own class, and in many cases to classes other than their own. This means that in most schools where departmentalization or semi-departmentalization is being used, teachers who feel competent in teaching science are teaching this subject for teachers who feel less competent.

5. There is a significant relationship between teachers' feelings of competence in teaching science and the type of plan they prefer for instruction in science. Most of the teachers who prefer to have science taught by the classroom teacher are teachers who feel competent in teaching science. Teachers who feel less competent in teaching science, tend to favor a type of organization where they may be relieved of

instructional responsibilities in teaching elementary school science.

Integration of Science with the Total Elementary Curriculum

Principals reported a significant relationship between the integration of science with other subject matter on the elementary school curriculum, and the location of the school. The majority of principals surveyed, reported that science was being integrated with enterprise activities. Science is not integrated with any other subject on the elementary curriculum, by about thirteen per cent of the provinces principals and teachers.

Equipment and Facilities to Accommodate the Elementary Science Program

This area was reported on by principals only.

1. Approximately forty-five per cent of the schools surveyed had buildings and furniture equipment adequate to accommodate the elementary school science program.

2. In the area of audio-visual aids that could be applied efficiently and easily to the science program, seventy-five per cent of the schools were adequately equipped.

3. Items relating to available printed materials for science instruction were reported in adequate supply by approximately three-quarters of the schools surveyed. However, there is an indication that slightly more than half of the schools surveyed were using only one series of authorized texts, and that other text book series and library books relating to science in either the reference or leisure reading categories were in short supply.

4. There is no significant relationship between the science equipment rating of the schools surveyed, using Provincial Science Bulletin IIb as a guide and the location of the school.

5. There was no significant relationship between the method of obtaining science equipment for daily use and the location of the principal's school.

Suggestions for Improvement of the Elementary Science Program

Suggestions for improvement resolved themselves into six categories. Improvement of the physical facilities, shortage of all types of teaching materials, the organization of the science program in the school, the improvement of the professional qualifications of science teachers, the enrichment of the science program by the use of outside agencies and professionals, and

the improper use of text book materials, the overlapping science curriculum, and large classroom enrollments.

III. IMPLICATIONS AND RECOMMENDATIONS

Examination of the findings discussed in this study leads to the conclusion that improvements might be made in several areas that relate to the organization and instruction in science of the elementary schools of the province of Alberta. The following implications and recommendations are structured according to organizational provisions in practice and preference for instruction in the elementary schools of Alberta, staff allocation, teacher education, school facilities, and further research.

Organizational Provisions for Instruction in Science

It has been indicated by this study that the majority of the principals and teachers in Alberta's elementary schools would prefer a type of organizational arrangement for instruction in science, other than the one they are presently using. While it does not necessarily follow that present and existing organizational arrangements are unsatisfactory, this does mean that many teachers are dissatisfied with present conditions and that both principals and teachers

believe that science might be taught using other organizational arrangements. There is a lack of positive evidence to indicate which type of organization is most suitable at different grade levels. The opinion of the majority of principals and teachers may be sufficient reason to suggest that some changes should be made.

To augment the above reason for change, this study indicates that between one-fifth and one-quarter of the teachers in the elementary schools of Alberta have had no professional training for teaching science, and ten per cent of the teachers do not feel sufficiently competent in teaching science education. It seems impractical to expect these teachers to teach science adequately. In addition, over half of the teachers surveyed had not upgraded their professional qualifications in the past ten years.

This study indicates that in schools where organizational arrangements have been made for teachers to have their science classes taught by another staff member, the persons assuming responsibility for science tend to be better qualified, to feel more competent in teaching science than the teachers they are relieving, and that they have had recent professional preparation at the university level. Having science taught by

teachers who are better qualified and who feel competent in teaching science, no doubt results in pupils receiving better science instruction. The interests of children are paramount, and all else ancillary or contributory to the realization of such interests.

This study reveals that more principals and teachers would prefer a system of departmentalization or semi-departmentalization for instruction in science in grades four to six, while most teachers would prefer to have science taught by the classroom teacher in grades one to three, by integrating it with other subject matter on the elementary curriculum. The relatively small size of many elementary schools, and the lack of qualified science personnel means that, in most cases, it is unrealistic to hope to have science taught by a special science instructor. It is possible, however, to make provision for teachers to "trade" subjects so that those with interest and ability in science may relieve other teachers of their responsibilities in this subject area. The opinion of principals and teachers in this study and in related studies and professional literature, suggests that in the primary grades science should be taught and integrated by the classroom teacher.

It is therefore recommended that in grades one to three science be taught by the classroom teacher,

with appropriate integration, but that in grades four to six organizational arrangements should be made to "trade" subjects or establish a system of departmentalization or semi-departmentalization so that science may be taught by those who are most capable of giving instruction in this subject. In larger schools a teacher who is so qualified should give assistance to the teachers of grades one to three, and be allowed to co-ordinate the elementary science program throughout the school. A system of team teaching with one member of the team being highly qualified in science might be used to advantage throughout every grade in the school.

In the province of Alberta, at the present time, most elementary teachers are expected to teach science to their own classes, and since this situation is likely to continue to exist for some time in many schools, every effort should be made to provide for science seminars, in-service meetings and encouragement in professional preparation for elementary science teachers. This means that qualified personnel should be engaged to act as supervisors or consultants in urban and rural school systems. With the organization of larger rural units and the personnel facilities of the urban centres, this should be possible in most cases.

Staff Allocation

More than a third of the principals and teachers surveyed in this study had taken two or more courses during their professional preparation. In addition to those teachers who have taken extra professional preparation in science there are probably many teachers who, because of background or interest, are very capable of teaching in the area of science. This was indicated in various sections of the questionnaire which provided for this type of determinant. An effort should be made in the selection and placement of teachers to see that on each elementary school staff, there is at least one teacher who is capable of relieving teachers who cannot teach science. This administrative practice appears to be considered in the placement of music and physical education personnel in some elementary schools, and by some school system personnel departments.

This study indicates that teachers recently subject to professional preparation tend to feel more competent in teaching science. This also has implications for staff allocation. By balancing staffs in regard to professional preparation, administrators will increase the possibility of each school having, at least, some teachers willing and perhaps capable in the area of elementary science.

Teacher Education

In this decade the majority of teachers in elementary classrooms are expected to teach their own science. As indicated by this study, many of these teachers have had no professional preparation for teaching this subject. As long as the present organizational arrangements in elementary schools exist, it is essential that prospective teachers receive some professional preparation for teaching science. Prospective elementary school teachers should be encouraged to specialize in science education so that they may assume responsibilities in this subject area throughout the elementary grades and classrooms. At the present time there are too few prospective teachers specializing in science, and almost all of those who do become qualified in this subject, are absorbed into junior and senior high schools of the province of Alberta.

School Facilities

The results of this study indicated that elementary schools have little in the way of adequate physical facilities for conducting a comprehensive science program. It is noted in a recent report of the department of education that the newest elementary schools in Alberta, are being constructed without adequate science facilities and science storage space. Audio-visual equipment

and available printed materials including science textbooks seem to be placed in the schools by the authorities, but there is little evidence to show that they are being utilized to their fullest extent. Recent reports indicate that science teachers continue to utilize only one series of authorized texts, and that teachers are loath to try the experimental and inquiry approaches (47). It may be time that school building committees and curriculum planners assessed the position of science in the elementary school curriculum and provided physical facilities to augment the printed and visual materials that are available.

Further Research

In the early pages of this study it was mentioned that traditional organization in elementary schools is being questioned and some modifications and changes are being recommended. There is a definite need for further research on organizational provisions and practices for teaching elementary science, and on organization for instruction in other elementary school subjects. Further research is needed as a basis for considering changes that might be made.

In the area of science there is a need for further research using the same general sources of data as those

used in this study, but the sources should be expanded in scope to include junior and senior high school personnel, individuals in industry and the social sciences, the Department of Education with its vast resources of information at hand, and the opinions of the faculty at our universities throughout the province. These sources may complement the findings of this study. There is also a need for research that would evaluate and compare the science programs offered under different types of instructional organization. The development of criteria to evaluate the science programs offered in different schools would make it possible to relate effectiveness to organizational arrangements, as well as to additional factors, such as, building facilities, teacher variables, size and location of school, supervisory assistance, and so on.

The composite results of research into all areas of the elementary curriculum coupled with detailed and specific assessments of the professional preferences of teachers in all subject areas, would undoubtedly precipitate many improvements in the elementary schools of Alberta.

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A P P E N D I C E S

APPENDIX A

APPENDIX B

APPENDIX C

APPENDIX D

APPENDIX A

LETTERS OF INSTRUCTIONS REGARDING QUESTIONNAIRE

May 26, 1967

With reference to out telephone conversation of May 25, 1967, regarding permission to place in one or more of the schools under your jurisdiction a science questionnaire concerning practice and preference in regard to science teaching in the elementary and elementary-junior high schools throughout the province of Alberta, may I please express my sincere thanks to you for allowing me to do this.

I was very concerned with the timing of this request, for I realize how late it is in the school term. A secondary concern was that it seems as if these types of requests are growing in number in recent years. Many principals and staffs are getting quite fed up. I do hope, however, that I will receive their replies, for I intend to send each superintendent and principal a complete summary of the results. You may expect this in the mail about mid-August of this year.

Again may I say thank you for your participation in this professional matter. A copy of the questionnaire is enclosed.

Yours truly,

W. A. Blench,
Principal, Montrose Elementary School

Montrose School,
11931-62 Street,
Edmonton, Alberta.

Dear - - -

May I please ask for your assistance. At the present time I am completing my graduate work in Elementary Education at the University of Alberta. As part of my work I am attempting a study of practice and preference in the teaching of Science in the Elementary and Elementary Junior High Schools of the Province of Alberta.

Sixty Elementary and Elementary Junior High Schools were chosen throughout Alberta, using a table of random numbers as applied to all of the operating schools in the province for the year 1966-67.

The enclosed material consists of two Questionnaires. Each questionnaire requires 5-7 minutes to complete. I would appreciate it if you could:

(1) Distribute a teacher questionnaire (white copy) to each Elementary and Elementary Junior High teacher (Grades 1 to 9 only) and ask them to complete it.

(2) Complete a principal's questionnaire yourself (yellow copy).

(3) If you are a principal and in charge of an Elementary Classroom please complete a teacher questionnaire as well, so that all elementary grades in the school will be represented.

(4) Collect and return all of the complete questionnaires.

Data collected will be reported for groups of schools and the identity of particular schools or teachers will not be revealed in the tabulation of results. Information from individual principals and teachers will be strictly confidential. I have contacted the Department of Education and your Superintendent in regard to this survey and permission has been given for its completion.

I am enclosing an addressed, stamped envelope, for your convenience in returning the questionnaires. I would appreciate having the questionnaires completed and returned by the 15th of June, 1967, if possible.

This time of each school year is perhaps the busiest but your co-operation in making this study possible will be greatly appreciated.

Yours truly,

Principal,
Montrose Elementary School,
Edmonton.

June 12, 1967.

Dear - - -

The purpose of this letter is two-fold. To thank those principals and staffs who have already returned the completed questionnaires on Practice and Preference in Elementary and Elementary Junior High Schools with regard to Science Instruction in the Province of Alberta.

I am grateful to you in this regard, for at this time of the year to ask such a favor is a bit presumptuous.

The second purpose is to ask those of you who have not yet found time to respond to do so at your earliest convenience.

I had hoped to have the returns in by the 15th of June, may I now request them by the 23rd of June.

The results of the questionnaire form the entire basis for my work at university this summer.

With your permission I intend to send in September to each participating principal a complete review of all research that is contained in this project.

May I again thank each of you for your efforts and co-operation and may I wish you a happy, restful, and "good-weather" summer.

Yours truly,

W. A. Blench,
Principal.

APPENDIX B

A STUDY OF OPERATIONAL PLANS FOR THE TEACHING OF SCIENCE IN THE ELEMENTARY SCHOOLS OF ALBERTA

PRINCIPAL QUESTIONNAIRE

The purpose of this questionnaire is to determine practice and preference in regard to science instruction.

The aim of the questionnaire is to gather information about the schools in general and not about particular schools. All replies will be treated confidentially.

Please answer the following questions as accurately as possible.

Thank you for your help in this study.

I. GENERAL INFORMATION

1. Name of school _____

2. Total number of classrooms in your school (circle one):

   1 - 5 6 - 11 12 - 17 18 or more

3. Total number of elementary classrooms in your school (circle one):

   1 - 5 6 - 11 12 - 17 18 or more

4. Total number of years of teaching experience, including the present year (circle one):

   1 - 3 4 - 6 7 - 9 10 or more

5. Total number of years of teaching experience, including the present year, in elementary school (circle one):

   1 - 3 4 - 6 7 - 9 10 or more

6. Sex Male Female (circle one)

7. Total number of years as a Principal of your present school (circle one):

   1 - 3 4 - 6 7 - 9 10 or more

8. Total number of years as Principal of your present school (circle one):

   1 2 3 4 5 6 or more

9. What fraction of your time do you have free of teaching duties that you may devote to administration and supervision of instruction (circle one):

   all 9/10 8/10 7/10 6/10 5/10 4/10 3/10 2/10
   1/10 none

10. Total number of years of education, as for salary purposes (circle one):

1 2 3 4 5 6 more than 6.

11. In which route was your professional education? (circle one):

Elementary Secondary

12. Number of science courses you have taken as part of your professional training:

_____

(Count only those courses that are recognized as credit courses by the University and Department of Education for certification purposes, and beyond certification.)

II. PRACTICE IN REGARD TO THE TEACHING OF SCIENCE IN YOUR SCHOOL

1. Check the item below which best describes how science is taught in your school at each of the indicated grade levels.

	GRADE LEVEL					
	1	2	3	4	5	6
(a) Science is taught by the classroom teacher.						
(b) Science is taught by a classroom teacher in the school as part of a system of departmentalization or semi-departmentalization in which teachers "trade" subjects.						
(c) Science is taught by a special science instructor who is a member of the school staff.						
(d) Science is taught by a visiting specialist employed by the district or school system.						
(e) Another plan entirely different from those mentioned in (a) to (d) above.						

(If item (e) above has been checked, please explain.)

_____

_____

_____

2. How is science teaching organized in your school? Please check one of the items below at each of the appropriate grade levels.



GRADE LEVEL					
1	2	3	4	5	6

(a) As a separate subject.

(b) Completely integrated with other subjects.

(c) Taught primarily as a separate subject but with appropriate integration and correlation.

(d) Other

(If you have checked (d) above please explain below.)

_____

_____

_____

3. If science is integrated with other subject areas, indicate at the appropriate grade level the subject with which science is integrated.

GRADE LEVEL	Science integrated with subject named below
1	
2	
3	
4	
5	
6	

4. Is a science specialist employed by your unit or school system to give assistance to teachers in planning and teaching science?

Yes _____

No _____

(The above refers to science consultants or supervisors hired for the purpose of helping teachers through in-service work, demonstration lessons, planning programs, etc. If part time or other personnel are engaged in this function please explain.)

_____

_____

_____



III. PREFERENCE IN REGARD TO ORGANIZATION FOR INSTRUCTION IN SCIENCE

1. Check the item below which best describes the organizational plan which you would prefer for instruction in science in your school at each of the indicated grade levels

(a) Science taught by the classroom teacher.

(b) Science taught by a classroom teacher in the school as part of a system of departmentalization or semi-departmentalization in which teachers "trade" subjects.

(c) Science taught by a special science instructor who is a member of the school staff.

(d) Science taught by a visiting specialist employed by the district or school system.

(e) Another plan entirely different from those mentioned in (a) to (d) above.

	GRADE LEVEL					
	1	2	3	4	5	6
(a)						
(b)						
(c)						
(d)						
(e)						

(If (e) above is checked please explain your plan)

_____

_____

_____

2. Has your school the following facilities or equipment for science instruction?

	Yes	No
(a) Separate room for science instruction?	___	___
(b) Tables that can be used for science demonstrations?	___	___
(c) A portable science demonstration cupboard or unit?	___	___
(d) Sink and water supply in rooms?	___	___
(e) Other facilities	___	___

(If (e) above has been checked "yes" please specify these facilities in spaces below.)

_____

_____

_____



3. Has your school the following A/V facilities or equipment for science instruction:

	Yes	No
(a) An overhead projector?	___	___
(b) A filmstrip projector?	___	___
(c) A 16mm. film projector?	___	___
(d) Projection screens?	___	___
(e) Models)plastic, metal, cardboard, etc.)?	___	___
(f) Transparencies of scientific teaching material?	___	___

(If (g) above has been checked "yes" please specify these facilities in the spaces below.)

_____

_____

_____

4. Has your school the following printed materials for science instruction:

	Yes	No
(a) One authorized series of science textbooks for each grade?	___	___
(b) More than one authorized series of textbooks?	___	___
(c) Additional series of science textbooks not authorized but used as enrichment?	___	___
(d) Science charts (e.g. The Earth's Crust)?	___	___
(e) Other materials?	___	___

(If (e) above has been checked "yes" please specify other materials in spaces below.)

_____

_____

_____

5. If the equipment listed in Bulletin IIb is considered appropriate for a six room elementary school, then the science equipment in your school is equivalent to: (check one category)

	Please check one
(a) More than the amount noted in Bulletin IIb	_____
(b) The amount noted in Bulletin IIb	_____

Please check one

(c) One-half the amount noted in Bulletin IIb _____

(d) One-quarter the amount noted in Bulletin IIb _____

(e) Very little, if any, of the equipment noted in Bulletin IIb _____

6. The science equipment used in the elementary school is obtained for daily classroom use in the following manner: (check one please)

(a) Borrowed from the Junior High School. _____

(b) Obtained from a science storage room or cupboard in the school. _____

(c) Obtained from storage in the classroom where science is taught. _____

(d) Requisitioned from the school district for a specified period of time. _____

7. Which plan or plans are used in your school in teaching science: (Please check for each grade level)

	GRADE LEVEL					
	1	2	3	4	5	6
(a) A course set out in Provincial Bulletin IIb.						
(b) A course prepared locally for your district.						
(c) A course as outlined in one of the authorized series.						
(d) A course selected according to the interests of the classes.						
(e) No formal course of study.						
(f) Other.						

(If (f) above has been checked please specify in the spaces below)

_____

_____

_____



8. Indicate your rating of science as to the contribution it can make to the objectives of the total elementary school program. Please rate science at <u>each</u> grade level.

	GRADE LEVEL					
Excellent	1	2	3	4	5	6
Very Good						
Good						
Fair						
Poor						

9. Have you any suggestions as to how the science program might be improved in your school?



APPENDIX C

A STUDY OF OPERATIONAL PLANS FOR THE TEACHING OF SCIENCE IN THE ELEMENTARY SCHOOLS OF ALBERTA

TEACHER QUESTIONNAIRE

The purpose of this questionnaire is to determine practice and preference in regard to science instruction.

The aim of this questionnaire is to gather information about the schools in general and not about particular schools. All replies will be treated confidentially.

Please answer the following questions as accurately as possible.

Thank you for your help in this study.

I. GENERAL INFORMATION

1. Name of school _____

2. Teaching grade(s) _____

3. Sex male female (circle one)

4 Total number of years of teaching experience, including the present year.

(circle one) 1 - 3 4 - 6 7 - 9 10 or more

5. Total number of years of teaching experience, in the Elementary school, including the present year. (circle one)

1 - 3 4 - 6 7 - 9 10 or more

6. Total number of years of education as for salary purposes (circle one)

1 2 3 4 5 6 more than 6

7. In which route was your professional education? (circle one)

Elementary Secondary

8. Number of science courses you have taken as part of your professional training.

_____

(Count only those courses that are recognized as credit courses by the University and Department of Education for certification purposes, and beyond certification.)

II. PRACTICE IN REGARD TO THE TEACHING OF SCIENCE IN YOUR CLASSROOM

1. Number of classrooms, including your own, to which you are teaching science.

	GRADE LEVEL						
	1	2	3	4	5	6	Total
Number of classrooms							

2. Check the item below which best describes how you teach science in your classroom and/or other classrooms, at each of the indicated grade levels.

(a) Science is taught by the classroom teacher.

(b) Science is taught by a classroom teacher in the school as part of a system of departmentalization or semi-departmentalization in which teachers "trade" subjects.

(c) Science is taught by a special science instructor who is a member of the school staff.

(d) Science is taught by a visiting specialist employed by the district or school system.

(e) Another plan entirely different from those mentioned in (a) to (d) above.

	GRADE LEVEL					
	1	2	3	4	5	6

(If item (e) has been checked please explain below.)

_____

_____

_____

_____

3. How is science teaching organized in your classroom, and/or in other classrooms in which you teach science? Please check one of the items below at each of the appropriate grade levels.

(a) As a separate subject.

(b) Completely integrated with other subjects.

(c) Taught primarily as a separate subject but with appropriate integration and correlation.

(d) Other

GRADE LEVEL

1	2	3	4	5	6

(If you have checked (d) above, please explain below.)

_____

_____

III. PREFERENCE IN REGARD TO ORGANIZATION FOR INSTRUCTION IN SCIENCE

1. Check the item below which best describes the organizational plan which you would <u>prefer</u> for instruction in science at the grade(s) level that you are presently teaching.

(a) Science taught by the classroom teacher.

(b) Science taught by a classroom teacher in the school as part of a system of departmentalization or semi-departmentalization in which teachers "trade" subjects.

(c) Science is taught by a special science instructor who is a member of the school staff.

(d) Science is taught by a visiting specialist who is employed by the district or school system.

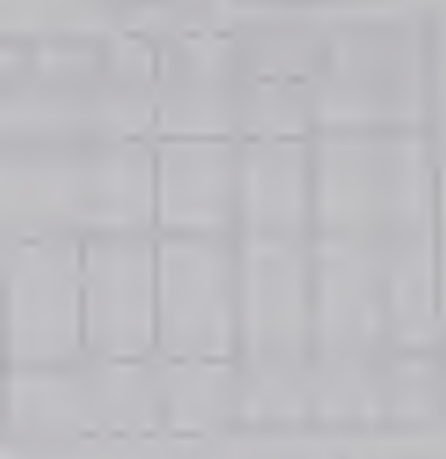
(e) Other Arrangements (Please specify below)

GRADE LEVEL

1	2	3	4	5	6

_____

_____





2. How would you prefer that science teaching be organixed in your classroom? Please check one of the items below at each of the appropriate grade levels.

	GRADE LEVEL					
	1	2	3	4	5	6
(a) As a separate subject.						
(b) Completely integrated with other subjects.						
(c) Taught primarily as a separate subject, but with appropriate integration and correlation.						
(d) Other						

(If you have checked (d) above please explain below.)

_____

_____

3. Check the term below which best describes your feelings of competence in teaching science at the grade level you teach.

	GRADE LEVEL					
	1	2	3	4	5	6
Excellent						
Good						
Adequate						
Below Average						
Poor						

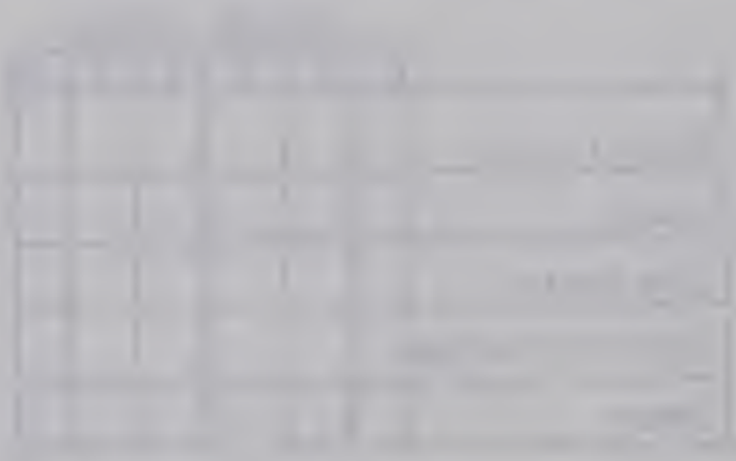
4. Which plan is followed in your classroom in teaching science? (please check)

	GRADE LEVEL					
	1	2	3	4	5	6
(a) A course set out in Provincial Bulletin IIb.						
(b) A course prepared locally for your district.						
(c) A course as outlined in one of the authorized series.						
(d) A course selected according to the interests of your class.						
(e) No formal course of study						
(f) Other (specify)						

_____

_____







5. Indicate your rating of science as to the contribution it can make to the objectives of the total elementary school program. Please rate science at each of the grade levels you teach.

	GRADE LEVEL					
	1	2	3	4	5	6
Excellent						
Very Good						
Good						
Fair						
Poor						

6. Have you any suggestions as to how the science program might be improved in your classroom?

_____

_____

_____

_____



APPENDIX D

BULLETIN IIb LIST OF ELEMENTARY SCIENCE EQUIPMENT

REFERENCE: Bulletin IIb Elementary School Science, Government of the Province of Alberta, Department of Education, Edmonton, Alberta. Printed by L. S. Wall, Printer to the Queen's Most Excellent Majesty, 1957, pp. 23-24.

The following list of materials is considered to be about the minimum number of items necessary to teach elementary school science. The list is for the purpose of assisting teachers in assembling the essential equipment for establishing a science program. It is divided into two parts:

1. Obtainable from Scientific Supply Houses
2. Obtainable from Local Sources

1. OBTAINABLE FROM SCIENTIFIC SUPPLY HOUSES:

Recommended Quantities	Description
1	Alcohol Lamp, glass, 4 oz.
3	Beakers, Pyrex 250 cc. @ 50¢
3	Beakers, Pyrex 400 cc. @ 50¢
12	Test Tubes, 7 x 7/8, per doz.
1	Battery Jar, 5 x 7
2	Dry Battery @ .95¢
2	Flask, Erlenmeyer, 500cc. @ .85¢
1	Funnel, glass 75 mm.
1 lb.	Tubing, glass 5 mm.
4	Rubber Stoppers, Solid No. 2 @5¢
2	Rubber Stoppers, 1 hole No. 2 @ 5¢
4	Rubber Stoppers, Solid No. 5 @ 10¢
2	Rubber Stoppers, 1 hole No. 5 @ 10¢
2	Rubber Stoppers, 2 hole No. 5 @ 10¢
2	Rubber Stoppers, Solid No. 7 @ 13¢
2	Rubber Stoppers, 1 hole No. 7 @ 13¢
4	ft. Rubber tubing ¼" inside diameter @ 25¢ per ft.
1	Supports, for test tubes, of wood, single deck, with 12 drying pins.
2	Clamp, nickled spring wire @ 20¢
1	Support, iron base and rings, 3", 4", and 5" complete
1	Wire gauze, galvanized, plain, 5"
20	ft. Wire, annunciator, copper No. 18 @ 10ft. for 10¢
1	Magnet, Bar 6" x ½" x ¼"
1	Magnet, U
1	Compass, small
1	Prism, glass 60 degrees, 3"
1	Osmosis Apparatus, thistle tube (double) with membrane
1 lb.	Iron filings
1	Lens, Convex
1	Lens, Concave
1	Tuning Fork, C1
1	Litmus, Red (100 strip)
1	Litmus, Blue (100 strip)

2. OBTAINABLE FROM LOCAL SOURCES

(a) Living Things

1. Fish, snails, water plants, etc., for aquarium
2. Turtle, frog, salamander for terrarium
3. Seeds, (bean, corn, etc.)
4. Growing Plants, (geranium, begonia, ivy, bulbs, cactus, mushrooms, etc.)
5. Algae, larvae of different kinds

(b) Glassware

1. Fruit jars
2. Milk bottles (and caps)
3. Glass tumblers
4. Lamp chimneys
5. Reading glass
6. Small mirrors
7. Pyrex nursing bottles
8. Compass
9. Window glass (4" or 6" squares)

(c) Construction Materials

1. Jars containing assorted nails, tacks, paper clips, screws, elastic bands, etc.
2. Hammer, pliers, file, knife, screw driver.
3. Glue, paste, shellac
4. Sandpaper
5. String and cord
6. Adhesive tape
7. Small tins of paint and varnish

(d) Chemicals

1. Soda
2. Starch
3. Sugar
4. Lime (Slaked)
5. Red ink
6. Vinegar
7. Table salt
8. Paraffin
9. Ammonia
10. Iodine
11. Dry ice

(e) Collections

1. Seeds
2. Leaves
3. Shells
4. Bird nests
5. Local rocks, minerals, etc.
6. Science pictures of various kinds
7. insects

(f) Miscellaneous

1. Box of garden soil (about 2 quarts)
2. Box of sand (about 2 quarts)
3. Box of sawdust
4. Flashlight bulbs and sockets
5. Balloons
6. Medicine dropper
7. Magnets
8. Blotters
9. Animal cage (or material to construct it)
10. Paper cups
11. Bowls and flower and pots
12. Pot-holder
13. Spoons of different metal
14. Old electric switches or push buttons
15. Old copper wire
16. Soda straws
17. Salt cartons
18. Toys (boats, blocks, trains, wagons, steam engine, airplanes, etc)
19. Old bicycle pump
20. Old clothes pulleys
21. Sponges
22. Tin can and stopper (syrup tin)
23. Mailing tubes
24. Old storage battery, and worn out dry cell
25. Cellophane (clear and colored)
26. Candles (large and small)
27. Old rubber hose (from bath spray)
28. Old light bulbs and fuses

TEACHER'S NOTES:

_____

_____

_____

_____

_____

_____

_____

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